NAVAL POSTGRADUATE SCHOOL

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THESIS

AN ANALYSIS OF COST GROWTH IN
THE F/A-18 AIRPLANE ACQUISITION PROGRAM

by

Joseph Wendell Dyer

December 1981

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This research analyzes the F/A-18 airplane acquisition program with respect to cost growth. It is noted that the development estimate of total program cost addressed the acquisition only 800 airplanes, but that a decision was made in 1978 to increase the inventory objective to 1366 airplanes. Addition the estimates of inflation (escalation) issued by the Office the Secretary of Defense are observed to be lower than the

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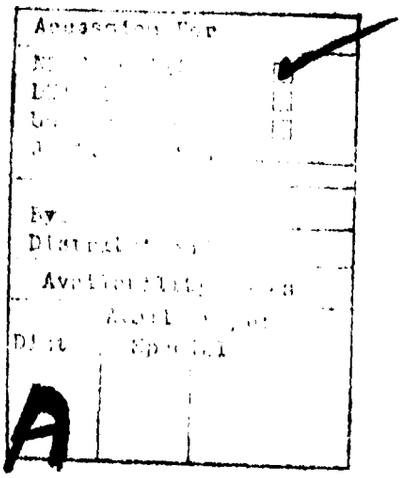

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An Analysis of Cost Growth in the F/A-18 Airplane Acquisition Program

by

Joseph Wendell Dyer
Lieutenant Commander, United States Navy
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Submitted in partial fulfillment of the requirements for the degree of

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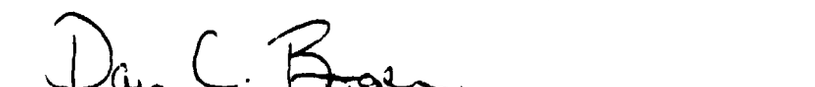
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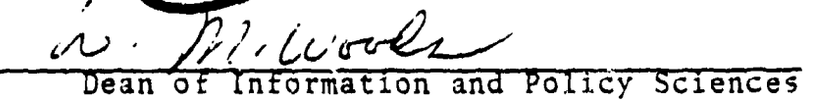
Dean of Information and Policy Sciences

ABSTRACT

This research analyzes the F/A-18 airplane acquisition program with respect to cost growth. It is noted that the development estimate of total program cost addressed the acquisition of only 800 airplanes, but that a decision was made in 1978 to increase the inventory objective to 1366 airplanes. Additionally, the estimates of inflation (escalation) issued by the Office of the Secretary of Defense are observed to be lower than the inflation actually experienced by the F/A-18 contractors. It is concluded that, as of December 1980, the program cost growth was only 10 percent when adjustments are made for both the quantity change and for actual inflation. It is further concluded that the program managers had little control over cost growth. Continued inflation and possible failure to realize the expected cost-quantity relationships are identified as likely areas of significant future cost growth.

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I. INTRODUCTION

The primary objective of this research is to realistically determine the magnitude of the F/A-18 program cost growth, and to identify the major factors which have contributed to this cost growth. After the primary factors are identified, an evaluation will be made to determine which cost growth factors are controllable and which factors are uncontrollable by the program manager. Finally, an attempt will be made to identify possible areas of future cost growth.

A subsidiary objective is to crystallize and summarize much of the literature pertinent to weapon systems cost and thereby to provide program managers with a manageable source of reference material.

A. DEFINITION OF KEY TERMS

Definitions of the following key terms are taken from The Navy RDT&E Management Guide: [1: C-1]

Development Estimate - The estimates of operational/technical characteristics, schedule and program acquisition cost for both development and procurement when approval is given for the program to move into full-scale development.

Current Estimate - The latest forecast of operational/technical, schedule and program acquisition cost.

Cost Growth - The current estimate of program acquisition cost minus the development estimate of program acquisition cost.

B. BACKGROUND

The F/A-18 "HORNET" strike fighter is a single seat, twin engine, jet airplane that is designed to operate both from ashore and from aircraft carriers. This single airplane is to be produced as a replacement for the aging F-4 fighter, and the A-7 and A-4 light attack airplanes. Initial Operational Capability (IOC) is scheduled for 1983. [2: 3]

The genesis of the F/A-18[1] was in the U.S. Air Force (USAF) lightweight fighter competition between the General Dynamics Corporation YF-16[2] and the Northrup Corporation YF-17. This competition was decided by a competitive flyoff between prototype airplanes and was won by the General Dynamics Corporation, single engine YF-16 in January of 1975. [3: 21]

The Department of Defense desire that there be a maximum of commonality between U.S. Navy and U.S.A.F. aircraft assets drove the Navy to strongly consider also selecting the YF-16. However, the YF-16 was rejected primarily for three reasons:

1. The Navy believed that the relative capabilities of the two airplanes were not demonstrated during the flyoff. (Northrup had conceded a performance advantage because the YF-17 design objectives related to maximum sustained maneuvering and

---

[1]The F/A-18 was originally proposed to be produced as separate fighter and attack models with high but not total commonality. Later in the program development both missions were incorporated into a single airframe/system.

[2]Aircraft identification symbols: Y = prototype, A = attack mission, and F = fighter mission.

acceleration were not realized until late in the competition.); 2. The YF-16 was not considered carrier adaptable because of an angle-of-attack limitation required for deck clearance in the landing configuration, and; 3. The Navy strongly desired the added safety provided by a twin engine airplane. [3: 21]

Northrup, who had no recent experience in producing carrier airplanes for the Navy, teamed with McDonnell Douglas Corporation (contractor for the F-4 airplane) and proposed a design for a carrier-adapted YF-17. This design was selected by the Navy in May of 1975 and the airplane was redesignated the F-18. McDonnell Douglas then became the prime contractor. [3: 21]

C. METHODOLOGY

This research was conducted in three forms: archival research, opinion research and analytic research.

The archival research centered around the F/A-18 program Selected Acquisition Reports. The Selected Acquisition Reports provide a standard, comprehensive summary status report which reflects the program manager's current best estimate of cost goals and compares these estimates with baseline parameters. Congressional records, Office of the Secretary of Defense studies and professional periodicals were also employed during the archival research. Additionally, an extensive search of literature relating to the program management environment, to weapon system cost management methods, concepts, and technique, and to inflation and measurements of inflation was conducted.

Opinion research was conducted via interviews with present and recently retired officials from the Naval Air Systems Command, Office of the Secretary of Defense, Naval Material Command, and from the Aerospace Industry. In total, over forty-five interviews were conducted in Washington, D.C. and St. Louis, Missouri. This opinion research focused on the managerial, technical, and political background needed to properly interpret the archival information.

Analytic methods were used to investigate the effects of assumptions regarding cost-quantity relationship on program cost.

D. LIMITATIONS

The limited available research time (approximately six months) required that F/A-18 cost growth be analyzed in the broad aggregate. Therefore, no attempt was made to identify specific causal factors of program cost growth. An analysis of program cost down to individual subcontractors and government field activities levels would no doubt be enlightening, but there the database grows geometrically, and becomes unmanageable by a single researcher.

Time limitations also precluded shoulder-to-shoulder comparisons of F/A-18 program cost growth history with that of other tactical airplane acquisition programs.

A limitation was placed on the timeliness of archival data utilized in this research. The latest archival data used

was as of December 1980. This information cut-off was established because this was the latest data available which was required to be in agreement with the President's annual budget submission. The requirement for agreement between the Selected Acquisition Report data and the budget submission provided higher confidence in these data. No such "as of" restriction was placed on the information collected during opinion research.

In an attempt to create an informal environment in which interviewees could freely discuss weapons systems cost growth, all interviewees were assured that they would only be identified by the position they held or had held.

E. ORDER OF PRESENTATION

This thesis is organized so that Chapter Two provides the reader with the background needed to understand the analysis presented in Chapter Three. Readers who are thoroughly familiar with weapons system program management and measurements of inflation may omit Chapter Two without loss. However, this chapter provides a compilation of the multi-disciplinary material relating to weapons system acquisition management in general and system cost growth in particular. Chapter Three analyzes the history of the F/A-18 program cost from the formulation of the development estimate through the current estimate of December 1980. The magnitude and controllability of program cost growth is evaluated, areas of cost growth are identified, and possible areas of future cost growth are discussed. Chapter

Four presents general and specific conclusions relating to the analysis of F/A-18 program cost growth.

II. REVIEW OF EXISTING LITERATURE RELATING TO WEAPONS SYSTEM ACQUISITION

The purpose of this chapter is to survey the literature pertinent to the research described in Chapter One. Sources of bibliographic information included library card catalogues, the Business Periodical Index, and a number of electronic databases serviced and/or maintained by private industry and by the Department of Defense. The non-government databases searched included DIALOG (Lockheed Corporation), ORBIT (SDC Corporation), INFOBANK (New York Times), and BRS (Bibliographic Retrieval Services). The Department of Defense data bank, which yielded the greatest information, was DLSIE or the Defense Logistics Studies Information Exchange. Keywords identified for the database searcher were: cost growth, price analysis, material acquisition, cost information reports, cost tracking, inflation, index numbers, aerospace industries, and cost estimating.

The goals of this chapter are twofold. First, the material that follows is designed to assist the reader in the interpretation of the F-18 program cost growth analysis presented in Chapter Three. Concepts and definitions presented here are designed to provide a departure point and a focus for that analysis. Secondly, it must be recognized that the literature addressing weapon systems cost growth is multi-disciplinary and often impresses readers as similar to the fabled blind

men describing an elephant. An attempt has been made to crystallize and summarize much of the pertinent literature and thereby to provide program managers with a manageable source of reference material that will itself contribute to broadening of the body of knowledge.

This chapter is divided into three major divisions. The first, Program Management, and the Acquisition Environment, addresses the program management concept and then addresses the Department of Defense acquisition and budgeting processes. The major weapon system summary status report is also addressed in this section. The next section, Methods, Concepts, and Techniques, looks at establishment of a datum from which cost growth is measured, system changes, production learning and contract types. The last section, Inflation and Measurement of Inflation, briefly touches upon some inflation theories and then addresses the application of index numbers by tracking the cost of a hypothetical airplane (the X-99) program during an inflationary period. Finally, some caution is urged in application of purely aerospace price indexes.

A. PROGRAM MANAGEMENT AND THE ACQUISITION ENVIRONMENT

This section defines, depicts and discusses the program management concept. Then, the acquisition environment is discussed in terms of the major weapon system recommending body (the Defense Systems Acquisition Review Council) and the funding process (the planning, programming, and budgeting

system.) Lastly, the selected acquisition report system is defined and discussed. The F/A-18 Selected Acquisition Reports are the main source of cost data which will be analyzed in Chapter Three.

1. Program Management

Program management is the central organizational mechanism for integrating the Department of Defense research, development, test, and evaluation efforts required for systems acquisition. The central tenet of program management is organization by output or purpose [1: 1-7]. The program manager is appointed to be the advocate of that purpose and is held accountable for program success [4: 87].

a. Matrix Organization

Using Figure 1, observations and analysis made by Hellriegel and Slocum of a project management (matrix) organization in a commercial industrial situation can be applied to Naval Air Systems Command program management [5: 59-68].

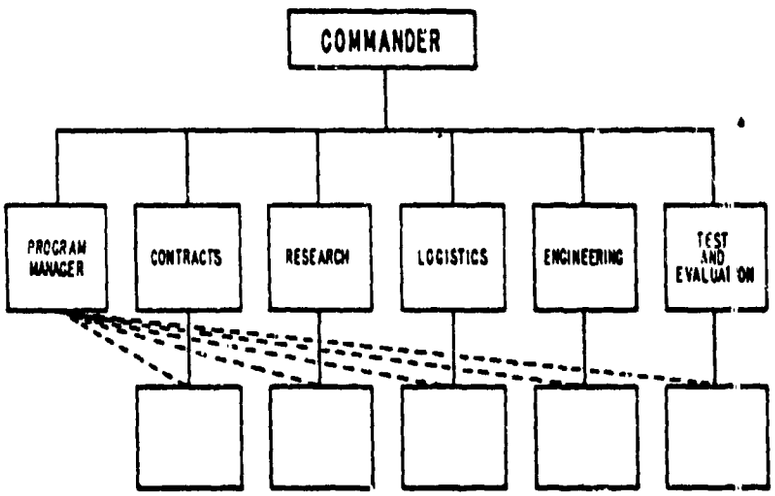

Figure 1. Abbreviated Naval Air Systems Command Organization

Functional managers (Engineering, Test and Evaluation, etc.) are responsible to the Commander, Naval Air Systems Command for their activities. The program manager is chartered by, and reports to, the same top manager and has personnel from the functional divisions (and from field activities) assigned to him as required on a temporary basis. Clearly, there are dual authority relationships associated with each of these "temporary" program team members. Hellriegel and Slocum state:

> The project manager's authority flows horizontally across the superior-subordinate relationships existing within the functional activities of an organization. Throughout the life span of a given project, personnel at various levels and with varying skills must contribute their efforts to allow for the sequential development of the project...His (the project manager's) authority is de facto and stems from his charge from top management to get the project done within time and cost constraints. In practice, the project manager must rely heavily upon his peers through negotiations, knowledge and resolutions of conflict. These relationships replace the lack of formal authority over all the resources needed to complete the project.
>
> A model published by Hicks can be adapted to cast some further light on the responsibilities of a program manager. [6: 21-22]

The vector of energies expended by functional elements of an organization without the focus provided by a program manager is depicted in Figure 2a.

These energies are directed toward accomplishment of individual institutionalized functional goals and responsibilities. The formation of a program office and chartering of a single individual as program manager serves to redirect the more "random" energies of the various functional elements

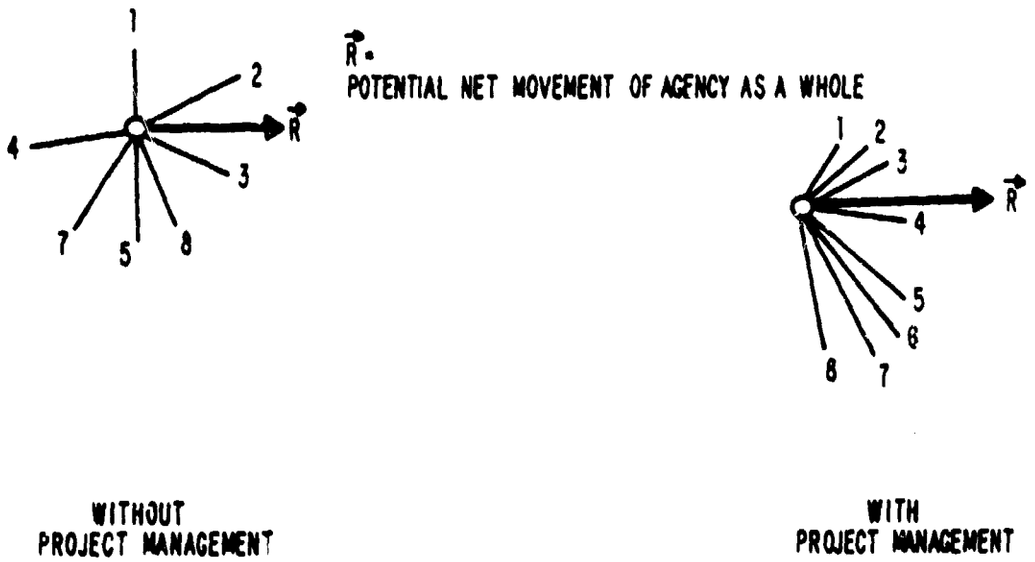

Figure 2. Vector of Organizational Energies

toward the program goal. (Note that some functional elements "line up" in support of the program goals better than others.) Archibald has noted that functional management can be seen as "divisive" management since the organization is divided along functional lines, while program management, like general management, is "integrative" in nature. [7: 35]

b. Forces Behind Program Management

John Kenneth Galbraith describes six "imperatives of technology" which he believes are at work pushing organizations toward the project management approach: [8: 25-28]

1. The time span between initiation and completion of a project is increasing.

2. The capital commitment to a program prior to actual use of the end product is increasing.

3. With increasing technology, the commitment of time and money tend to be made more inflexibly.

4. Technology requires more and more specialized manpower.

5. The inevitable counterpart of specialization is organization.

6. More effective planning and control are required because of all of the above.

Certainly these technological imperatives are operative within the defense establishment.

2. Defense Systems Acquisition Review Council

When David Packard[1] took over as Deputy Secretary of Defense in 1969, he was given primary responsibility for Defense Acquisition Policy. He quickly undertook a number of policy initiatives designed to improve the existing acquisition environment. First, among these was to "provide for systematic program reviews at important decision milestones by a group of senior officials in the Office of the Secretary of Defense." [9: 1]

This program review process was codified in Department of Defense Directive 5000.1 of 1975 and was known as the Defense Systems Acquisition Review Council (DSARC).[2] [9: 2]

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[1]Mr. Packard served as Deputy Secretary of Defense from 1969 to 1971.

[2]Changes to the DSARC are currently being discussed by the Reagan Administration. A 30 April, 1981, memorandum from

The DSARC serves as an advisory body whose principal members include: [10: 3-4]

- The Defense Acquisition Executive
- Under Secretary of Defense for Policy
- Under Secretary of Defense for Research and Engineering
- Assistant Secretary of Defense (Comptroller)
- Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics)
- Assistant Secretary of Defense (Program Analysis and Evaluation)
- Chairman, Joint Chiefs of Staff

These council members, assisted by other defense and service personnel, render "decisions" (really recommendations) at major program Milestones I, II, and III. These milestones are depicted in Figure 3 [11: 1-8].

The acquisition process emerges from fleet operational experience, technological advances and intelligence assessment of the threat. All of these are integrated through ongoing mission area analysis. If a need of sufficient importance and priority is identified, a mission element need statement (MENS) will be written by the service and submitted to the Secretary of Defense. [12: 5]

Emphasis on the "front end" or problem definition (mission need) is required. As may be seen in Figure 4, the

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Deputy Secretary of Defense Frank C. Carlucci, discussing these changes is provided in Appendix A.

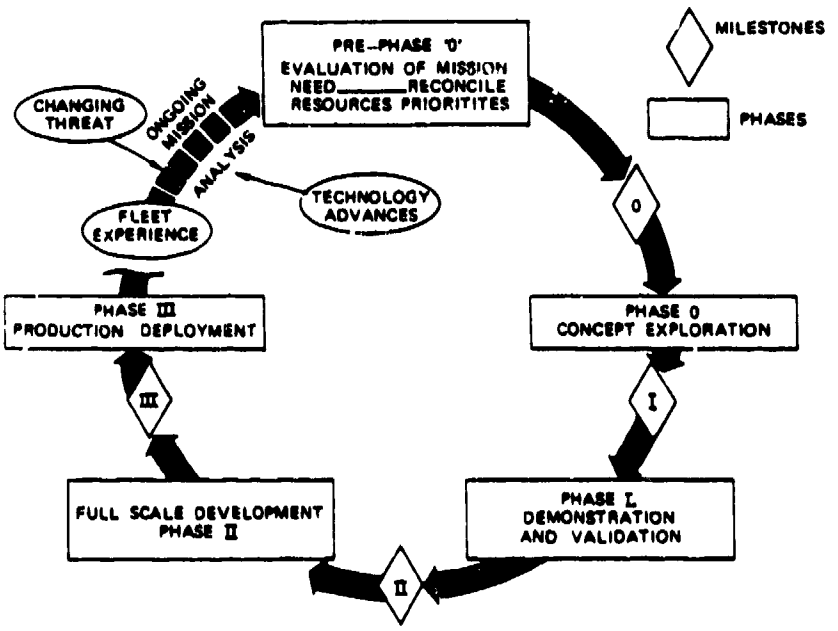

Figure 3. Acquisition Phases and Milestones

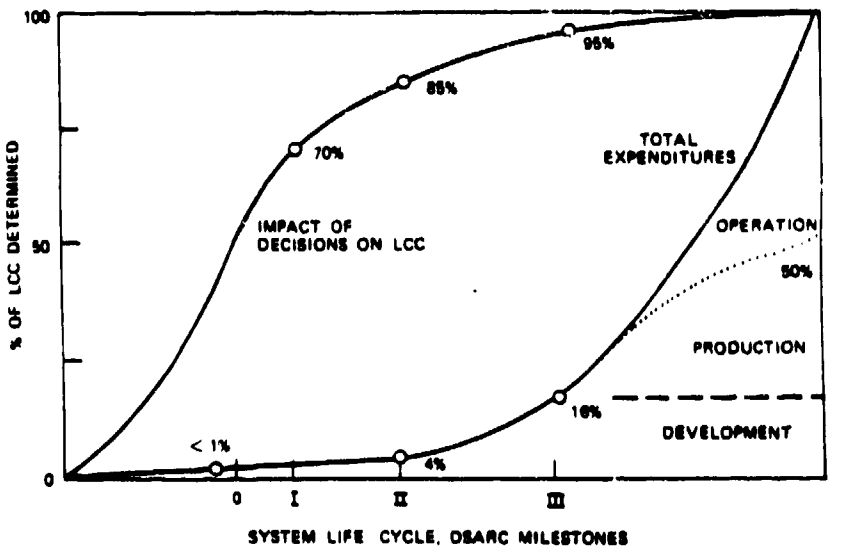

Figure 4. System Life Cycle Cost

Navy Program Manager's Guide maintains that approximately 70% of a system's life cycle cost is predetermined by the concept chosen to meet the mission need.[3] [11: 1-6]

If the MENS is approved (Milestone 0), the Secretary of Defense directs the service to initiate Phase 0 and therein, "systematically and progressively explore and develop alternative system concepts to satisfy the approved need." [1: 2-25, 11: 1-9] (There is no DSARC meeting/decision at Milestone 0.)

At Milestone 1, after the service has completed the competitive exploration of alternative system concepts to the point where the selected alternatives warrant system demonstration, the Service Secretary requests approval to proceed with demonstration and validation [1: 2-22]. This request is reviewed and a recommendation is made by DSARC (Milestone 1) prior to the Secretary of Defense's decision. If the Secretary approves, models are fabricated to demonstrate and validate the critical technical and operational features of the selected concepts (Phase 1). [11: 1-10]

If Phase I is successfully completed, the service requests permission to initiate full scale development. Again, the DSARC meets to make a recommendation to the Secretary of

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[3]No research or statistical evidence was offered in the Navy Program Manager's Guide to support 70% or the other percentages shown on this figure. One of the editors of that publication maintains that the percentages represent "expert opinion."

Defense (Milestone II). If he gives his blessing, the program enters Phase II where the goal is to produce a fully tested, documented, and production-engineered design of the selected concept (s) from Phase I [11: 1-10]. This full scale system is subjected to both technical and operational test and evaluation during Phase II.

If Phase II is successfully completed, the service requests via DSARC, (Milestone III), that the Secretary of Defense grant permission to proceed with the planned procurement and fleet introduction of the selected system [11: 1-11].

Thus, DSARC does provide the Department of Defense with a control mechanism by reviewing program progress at major decision points distributed throughout the program evolution.

3. Planning, Programming and Budgeting System

a. Federal Budget Process

Before presenting the Planning, Programming and Budgeting System (PPBS) the more general budget process will be briefly addressed. The purpose of the Federal budget process is to allocate scarce national resources among competing public demands [13: A-3]. Figure 5 depicts the main three phases of the process: (1) Executive Formulation; (2) Congressional Enactment; and (3) Budget Execution. In the Defense Department Executive Formulation is carried out in a PPBS context.

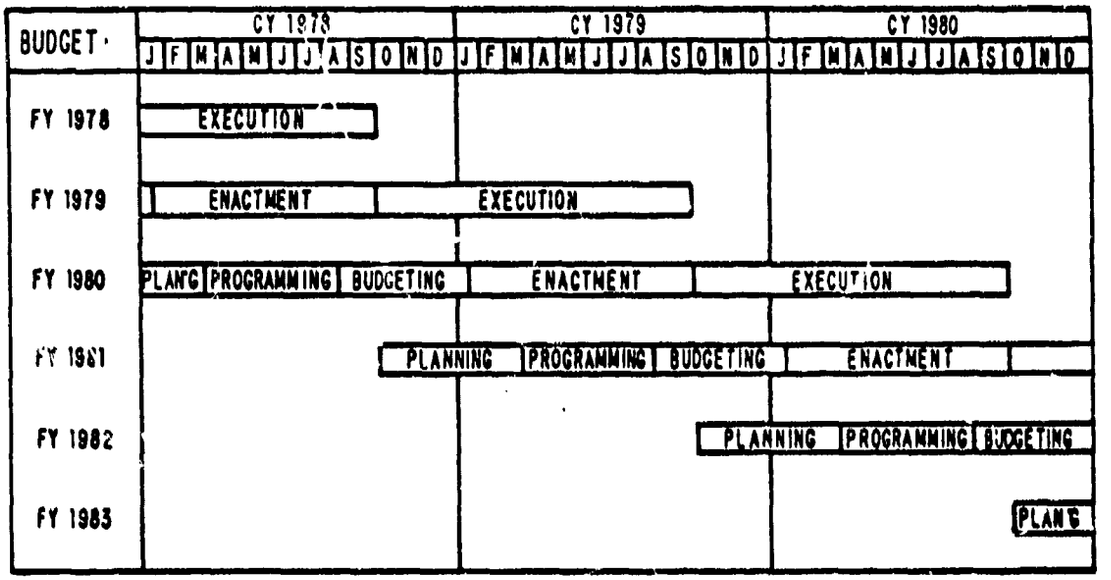

Figure 5. Phases of the Federal Budget Process

It is important to recognize that each of these main phases interrelates and overlaps. For example, a Defense Department program manager would have been concurrently involved in executing (spending) the Fiscal Year (FY) 1979 budget appropriations; testifying before Congress in support of the FY 1980 budget enactment, and planning for the FY 1981 budget. All this would have been transpiring during the month of February, 1979.

Note also that within each budget cycle there is a two year time delay from the initiation of budget planning until the beginning of the execution phase.

b. PPBS Concepts

McKinney and Howard state that PPBS provides a method or approach whereby, "objectives and resources and their interrelations are taken into account to achieve a coherent whole. Three major concepts underlie PPBS." [14: 3267]

- Development in [an] agency of an analytical capability to examine in depth both agency objectives and the various programs to meet the objectives;
- Formulation of a multi-year (at least five years) planning and programming process coupled with a sophisticated management information system; and
- Creation of an improved budgetary mechanism that can facilitate broad program decisions, translate them into more refined decisions in a budgetary context, and then present the results for executive and legislative action.

The PPBS approach is premised on questions such as the following:

- What are the basic goals and objectives being sought?
- What are the alternative means for achieving the stated goals and objectives?
- What are the comprehensive costs (present, future, and full of each alternative, both in financial and non-financial terms?
- What are the benefits to be achieved from each alternative and how effective will each be in achieving the stated goals and objectives?

c. Department of Defense PPBS Process

In keeping with concepts discussed above, the Department of Defense instituted PPBS in the early 1960's. The goal was to facilitate budgeting in terms of forces and systems rather than resource categories [15: 71]. The progression is from general articulation of national military

strategy and objectives to specific programs, organizations and forces necessary to carry out the strategy and objectives.

A model for viewing the Department of Defense PPBS is provided in Figure 6 [13: A-12].

The planning phase of PPBS is initiated with submission of the Joint Strategic Planning Document (JSPD) and ends with issuance of the Consolidated Guidance.

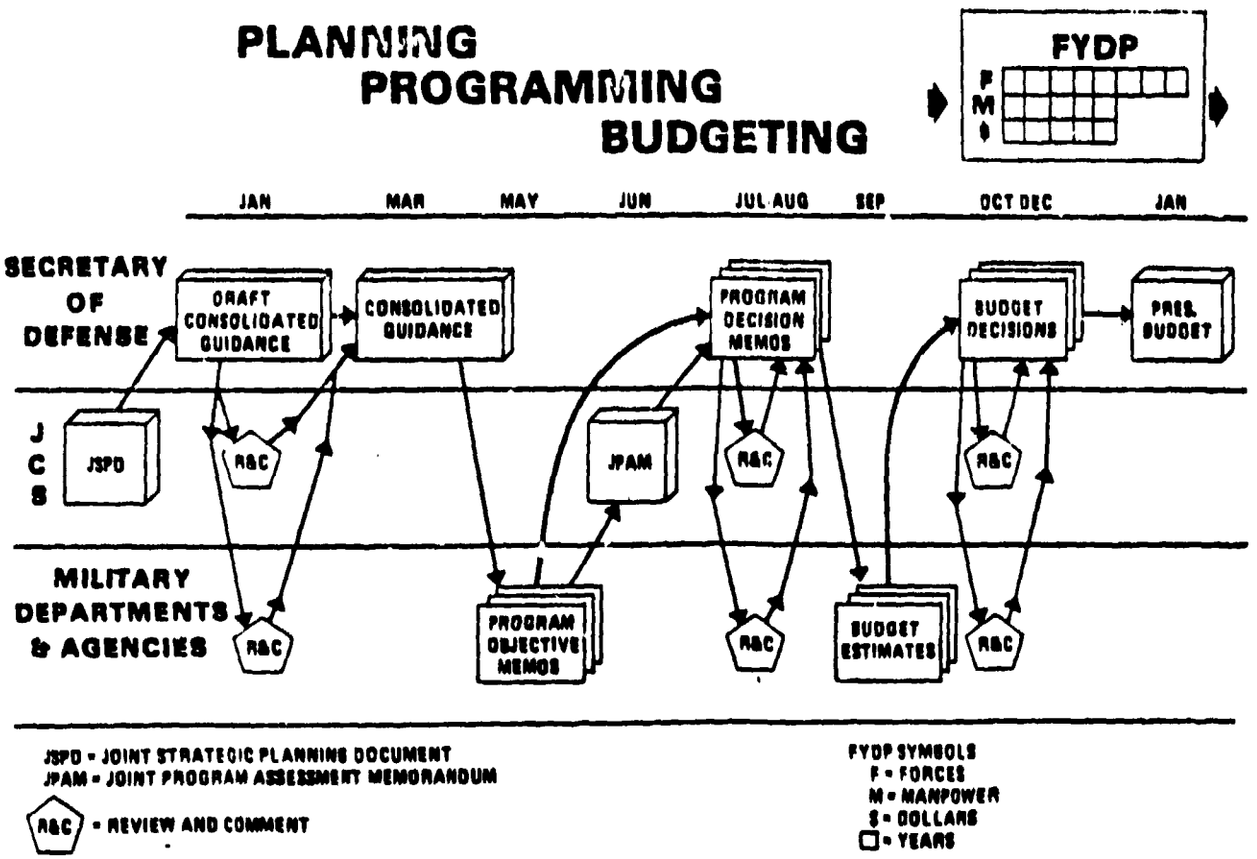

Figure 6. Planning, Programming, & Budgeting System

The JSPD provides the views of the uniformed military (Joint Chiefs of Staff) on policy objectives, national military strategy, and force levels. The JSPD is not fiscally constrained and is based on short-, mid-, and long-range intelligence studies. This document is published in early fall and is an input into the Consolidated Guidance.

The Consolidated Guidance is prepared for the Secretary of Defense by the Assistant Secretary of Defense (Program Analysis and Evaluation) with inputs from throughout the Office of the Secretary of Defense. The Consolidated Guidance contains a statement of fundamental policy and rationale underlying the defense program. Programming and fiscal guidance is also included to provide the services with the information needed to develop their programs. After a draft is discussed with the Joint Chiefs of Staff and with the Service Secretaries, a revised Consolidated Guidance is released to the Services in March.

The Program Objectives Memorandum (POM) is the programming link or bridge between planning and budgeting. It is here, in the programming phase of PPBS, where a program gains approval for development by standing up to competition against alternative means of accomplishing the same purposes and alternative uses of the same resources.

The POM is a definite statement on <u>how</u> the service intends to carry out their responsibilities with respect to

the national strategy. The "how" is constrained by the fiscal guidance in the consolidated guidance.

The POM is transmitted to the Secretary of Defense via the Joint Chiefs of Staff. The Joint Chiefs review the POM's (one is prepared by each service) and write the Joint Program Assessment Memorandum (JPAM). This memorandum is the Joint Chiefs of Staff view on the risk associated with the POM. (Remember that the POM is fiscally constrained whereas the JSPD was not).

After the POM and the JPAM are received, the Secretary of Defense reviews the memoranda and identifies alternatives for those issues where the Office of the Secretary of Defense and the Service differ. After the Joint Chiefs and the services have an opportunity to reclama, the Secretary of Defense issues the Program Decision Memorandum (PDM). The PDM is the Secretary of Defense's decisions on acquisition programs, force levels, and levels of support. The issuance of this PDM is the end of the programming phase of PPBS.

Upon receipt of the PDM, the service prepares firm budget estimates of the cost of the programs approved in the PDM. These budget estimates are sent directly to the Office of the Secretary of Defense for further analysis.

The Secretary of Defense holds budget hearings with the Services, Joint Chiefs of Staff and the Office of Management and Budget. Following these hearings, the Secretary

formulates his budget decisions. These budget decisions are then submitted for incorporation in the President's budget which is submitted to the Congress.[4]

d. Five Year Defense Plan

The Five Year Defense Plan (FYDP) is an official Office of the Secretary of Defense publication which summarizes the approved plans and programs of the Department of Defense components. More simply stated, it is the management information system (database) that supports the PPBS. The FYDP records, summarizes and displays budget decisions that have been approved by the Secretary of Defense. The FYDP is structured as modeled in Figure 7. [13: A-8]

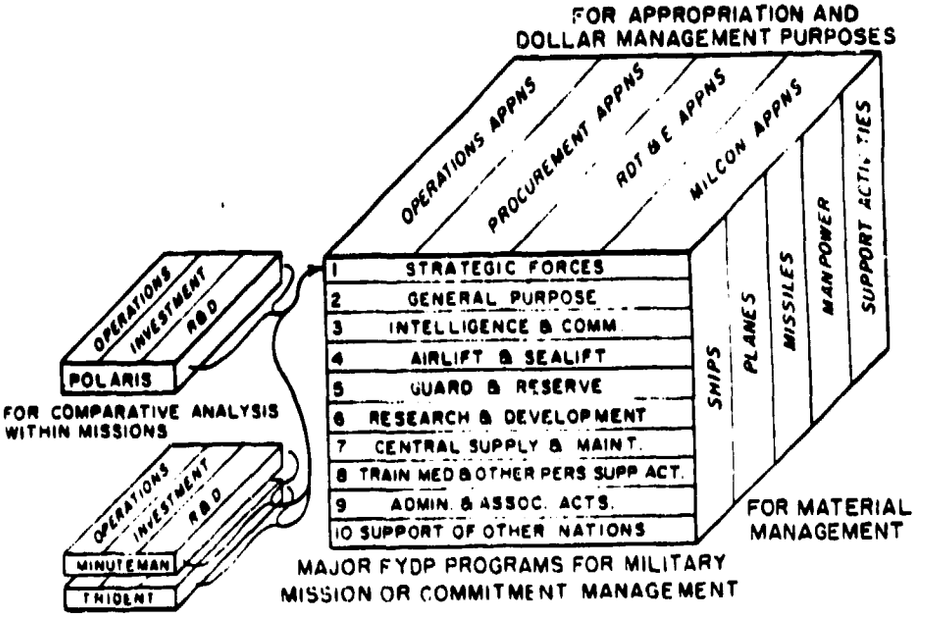

Figure 7. The Five Year Defense Plan Data Base

[4]Changes to the Department of Defense PPBS are currently being discussed by the Reagan Administration. A 27 March 1981

This structure allows different aggregations of data that would be meaningful to different managers. For example, a researcher or analyst seeking information on F-18 airplane research and development budgets could query this PPBS database by defining the year of interest and (X, Y, Z) coordinates. He would find the needed information under: (RDT&E appropriations, general purpose forces, planes).

The FYDP is updated in October, after Congressional action on the appropriations bill, in January after the President submits his budget and in May based on the POM. [13: A-9]

e. PPBS - DSARC Interface

It should be recognized that DSARC is "event" oriented. That is, a program proceeds from one DSARC milestone to another by accomplishing technological goals, (i.e. successfully completing the validation and demonstration phase followed by receiving a DSARC recommendation to proceed with full scale development.) This can take several years. On the other hand PPBS is "time" oriented. PPBS runs on a tightly structured schedule of 24 months from beginning of planning until completion of enactment [11: 2-25]. Since major acquisition program decisions are made in the context of both DSARC and PPBS, there is a coordination problem. Decisions made through the DSARC

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memorandum from the Deputy Secretary of Defense Frank C. Carlucci discussing these changes is provided in Appendix B.

process must be reflected in the FYDP. This is accomplished via the POM. Successfully passing a DSARC milestone is no assurance of funding, and inclusion in the POM does not assure that the budget will not be cut downstream. If a DSARC milestone is completed "out of phase" with the POM process significant funding delays may be experienced. The program manager must follow these processes carefully, for his funding is in jeopardy at each step. [11: 2-25-2-27]

f. PPBS in Perspective

Charles Schultze, who at the time was director of the Bureau of the Budget, summarized a perspective of PPBS: [16]

> Learned articles have treated (PPBS) sometimes as the greatest thing since the invention of the wheel. Others attack it, either as a naive attempt to quantify and computerize the imponderable, or as an arrogant effort on the part of latter day technocrats to usurp the decision-making function in a political democracy.
>
> PPB is neither. It is a means of helping responsible officials make decisions. It is not a mechanical substitute for good judgement, political wisdom and leadership of those officials....

4. Selected Acquisition Reports

Department of Defense Instruction 7000.3 is the controlling document that sets forth the Selected Acquisition Reports (SAR) Program.

a. Objectives

The SAR is the standard, comprehensive summary status report on major defense acquisition programs. This report reflects the Program Manager's current best estimate

of performance, schedule, and cost goals and compares these estimates with baseline estimates established at DSARC Milestone II when the program was approved for full scale development. The SAR is not designed to be a decision document, but rather a standardized information reporting document. It has been likened to a "snapshot" taken at the end of each quarter reflecting a weapon system program's overall status.

b. Applicability

SAR coverage is normally limited to those weapon system acquisition programs that are expected to experience total cumulative financing for research, development, test and evaluation of over $100 million or cumulative production investment in excess of $500 million. (SAR coverage may also be directed by the Secretary of Defense for programs of major interest regardless of expected financing requirement.)

c. History [17: 9]

The SAR was conceived by the Assistant Secretary of Defense (Comptroller) in 1967 as an internal Department of Defense managerial report. However, in 1967, Senator John Stennis (D-Miss), Chairman of the Senate Armed Services Committee, requested that he be provided with periodic status reports on major weapon systems. The Secretary of Defense decided to use the SAR to fulfill this requirement. In 1975 this request for information was formalized in Public Law 94-106, and the SAR is now used throughout all Congressional Committees having defense responsibilities.

d. Coverage

The SAR's are formatted to address the following areas: [18: 2-2-2-27]

(1) References - displays most of the programmatic information on the weapon system and includes system description and mission.

(2) Summary - briefly states the significant development from program inception and focuses on major events and changes since last report.

(3) Operational/Technical Characteristics - lists the quantifiable design goals and reports demonstrated performance so far accomplished.

(4) Schedule Milestones - provides information concerning key program milestones encompassing the entire period from program initiation to award of first full-scale production contract.

(5) Program Acquisition Cost - summarizes all changes to both costs and quantities which have occurred since establishment of the program baseline.

(6) Contractor Cost - reports contractor cost information on all active prime and associate prime contracts valued in excess of $5 million.

(7) Variance Analysis - summarizes the reasons for changes from the baseline values.

(8) Budget Year and Out Year Programs - provides a breakdown by fiscal year of program acquisition cost and escalation applicable to the "Budget Year" and "Balance to Complete" segments of the current estimate.

(9) Cost Quantity Curves - provides for recurring unit flyaway cost-quantity constant dollars.

The SAR provides analysts and researchers with a very useful tool. This document, referenced to an approved baseline, provides a comprehensive and continuous record of changes throughout a program evolution.

B. METHODS, CONCEPTS, AND TECHNIQUES

This section discusses cost estimating techniques and the uncertainty implicit in preparing cost estimates. Cost estimates prepared very early in a program evolution provide the baseline from which cost growth is measured. An appreciation of cost estimate formulation is important to the analysis presented in Chapter Three. Next, the learning curve concept is addressed, as it applies to cost-quantity relationships. Engineering changes are discussed. Lastly, contract types are discussed as techniques for cost control.

1. Cost Estimation

Cost estimation methods provide the datum from which cost growth is measured. Every phase of defense planning, programming and budgeting is based on cost estimation and accuracy is a fundamental requirement if intelligent decisions are to be made with respect to effective employment of scarce dollar resources.

Cost estimating responsibilities for proposed Naval Aircraft Development Programs lie with by the Naval Air Systems Command. Independent cost estimations are made by the Office of the Chief of Naval Operations before initiation of the DSARC. Within the Department of Defense, the Cost Analysis Improvement Group (CAIG) provides the Defense Systems Acquisition Review Council with a review and evaluation of both the program cost estimates prepared within the Department of the Navy. [1: 2-24]

a. Costing Methodologies

Mainly two cost estimating methodologies are employed within the Department of Defense. One is an industrial engineering approach; the other is a Parametric Costing Technique.

The industrial engineering technique requires a detailed knowledge of final design. This method breaks the production process into basic building blocks and calculates all the parts, materials, and manhours required to construct the aggregate system. [19: 3]

The parametric costing technique starts with the overall characteristics of the system (such as size, complexity, or performance level,) and derives an estimate of cost. The derivation is based on a statistical analysis of the relationship between performance characteristics and physical characteristics experienced in logically related systems [19: 3; 1: 2-25].

The industrial engineering techniques require a detailed and thorough knowledge of production methods. But, since the Government engages in very little actual production activity, this method may be better suited to estimates produced by contractors than to Department of Defense cost estimates.

Parametric cost estimating has enjoyed laudable success. As an example, NASA estimated the cost of the Apollo moon landing program ($20 billion) using parametric methods to

within three percent when corrected for unexpected inflation [20: 125].

b. Estimates Reported in Selected Acquisition Reports

Once prepared, by whichever method, cost estimates are reported in the SAR. The following are definitions of estimates used in the SAR; the nomenclature indicates when the estimate was made: [1: C-1]

- Planning Estimate - The estimates of operational/technical characteristics, schedule and program acquisition cost (for both development and procurement) when approval is given for program initiation (Milestone 0).
- Development Estimate - The estimates of operational/technical characteristics, schedule and program acquisition cost for both development and procurement when approval is given for the program to move into full-scale development (Milestone II).
- Current Estimate - The latest estimate operational/technical characteristics, schedule and program acquisition cost to acquire the inventory objective quantity, including usage or losses, necessary to reach the inventory objective.

c. Estimating Error

As a program progresses in time the current estimate often begins to differ from the development estimate. This is because no estimating method can perfectly consider those future items that are unknown or those upcoming problems that are not recognized at program initiation. Consider Figure 8 which is an illustration (adapted to DSARC process) offered by Archibald [7: 23].

Note that the estimated cost for a program is not precisely known but lies somewhere within the shaded circle.

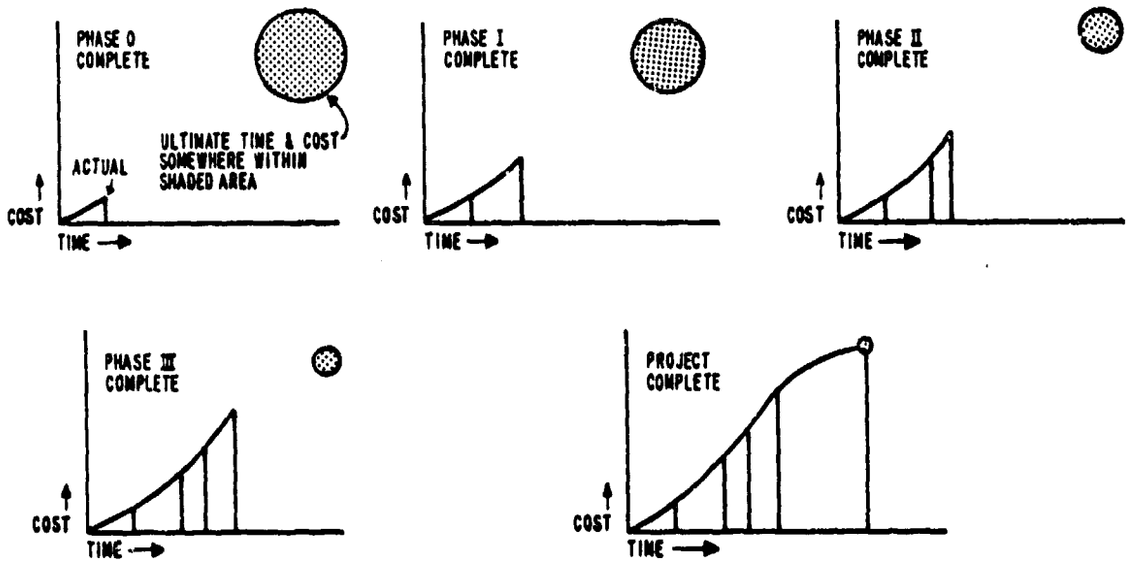

Figure 8. Relative Uncertainty of Ultimate Time and Cost

Early in a program life the area of the circle is large, reflecting the relative uncertainty of initial estimates. As a program matures the current estimates will be refined and the uncertainty (shaded) area will decrease in size reflecting decreased uncertainty. The location of the center of the shaded area will move left or right as the estimated scheduled time of development completion becomes more firm, and up or down as the estimated cost of the program comes into better focus.

However, cost estimates communicated with Congress in the Selected Acquisition Reports are reported as point estimates; that is, the location of the center of the uncertainty area on the vertical axis. Herein lies much of heartache of cost estimation accuracy. A point estimate does not provide any insight into the size of the area of uncertainty. Many researchers and analysts have proposed that point estimates of ultimate cost be replaced by a report of a confidence interval.

As an example, the probability distribution of a program cost estimate might be as pictured in Figure 9.

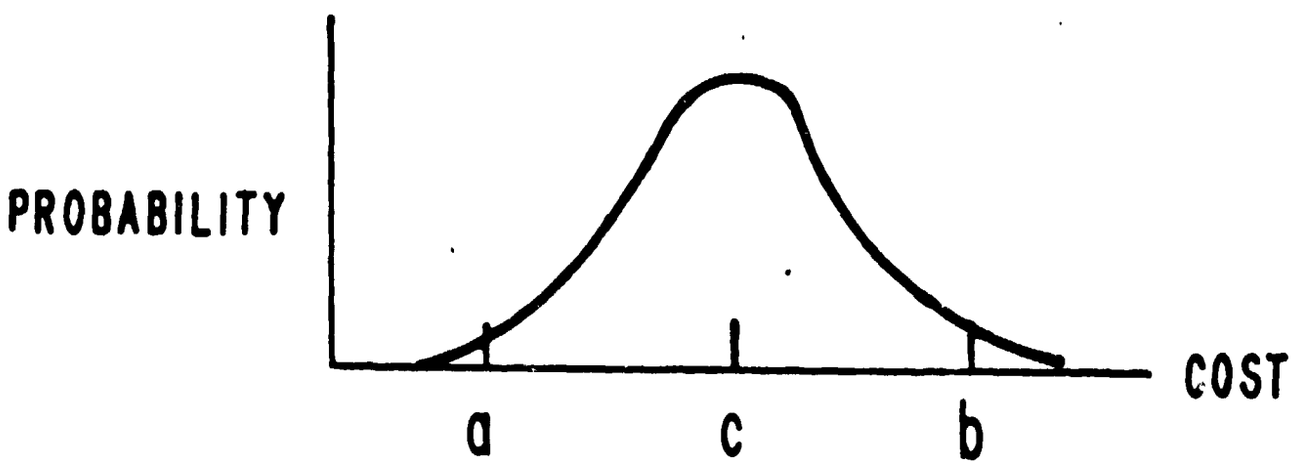

Figure 9. Probability Distribution of Program Cost

To report only the cost with the highest probability (c, a point estimate) is to withhold the assessment of program uncertainty.

It would be more meaningful to provide decision makers with a confidence interval that said the estimators have considered the uncertainties associated with the program and are 95 percent confident that the program cost will lie between a and b.

To gain more insight into the possible folly of dependence upon point estimates alone, consider the graph of cost estimates for two competing systems depicted in Figure 10.

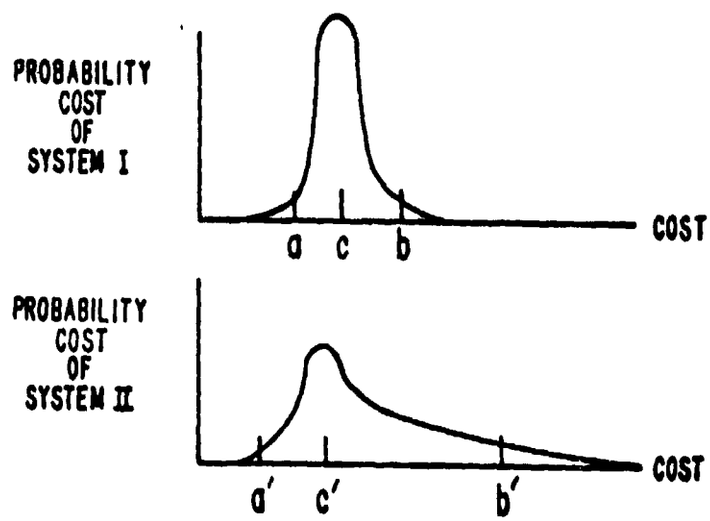

Figure 10. Probability Distribution of Program Cost--Competing Systems

The point estimate of the cost of System II (c') is lower than the point estimate of the cost of System I (c). Based upon point estimates of cost alone (and assuming equality of performance and schedule) a decision maker would decide to proceed with System II. But note that the cost estimators are 95 percent certain that the cost of System I will lie between a and b; a very narrow interval. The 95 percent confidence interval from System II is much broader and extends from a' to b' where b' is very much greater than b. If the confidence intervals are analyzed and risk is considered, a decision maker provided with this additional information may decide to proceed with System I even though it has a larger expected probable cost. To do otherwise is to risk experiencing the very large program cost b'.

d. Estimation of Economic Change

A major source of estimating errors in all programs has been inflation. Until approximately 1970 it was not common to include the effects of inflation (escalation) in program cost estimates [21: 18]. But during the mid to late seventies and early eighties inflation estimating errors began to constitute a large part of overall program cost estimation error. Accurately estimating inflation rates has proven illusive even though many complex econometric models have been developed and have demonstrated varying degrees of success.

Some of the uncertainty involved in predicting future inflation rates can be observed by using a simple linear regression model. This model assumes that there is an underlying linear relationship between time and inflation; and further, that the inflation rate observed (sampled) in any one year is a random variable with some probability distribution around the underlying linear function.[5] (See Wonnacott and Wonnacott for an explanation of regression theory [22: 331-355].)

If the assumed 1990 to 1995 inflation rates are plotted, regressed to a straight line and then extrapolated forward to future years, the results would appear as in Figure 11.

In year 1993, for which sample data was assumed available, it is indicated that one could 95 percent confident that the mean inflation rate was really between 7.64 percent and 4.17 percent. However, if this line is extrapolated forward in time the width of the confidence interval quickly broadens. Based on data collected from 1990 to 1995 it would be estimated that the mean inflation rate in 1999 would be expected to be 15.95 percent. But, to be 95 percent confident that the 1990 mean inflation rate was bounded, it would have to be reported that the 1990 mean inflation rate

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[5]This model is offered as an example in which uncertainty can be depicted. The intent is not to indicate that simple regression would be a good inflation model.

could be anywhere between 9.39 percent and 22.51 percent. And that would only be true if the underlying assumption (linearity) of the model was true. Certainly that assumption is not well founded. Unbeknownst to the analyst working in 1995, the 1996 election of a president with a vastly different national economic program could turn around the trend of increasing inflation. There will always be much uncertainty in the future.

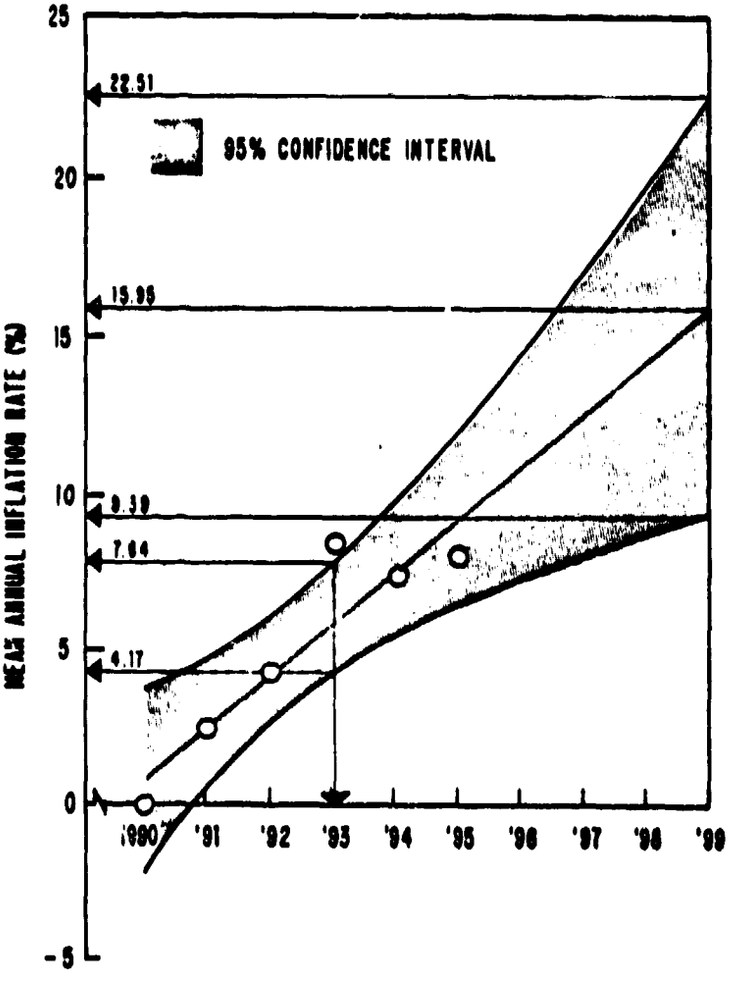

Figure 11. Estimates of Inflation--The Dangers of Extrapolation

2. Learning Curve

a. Learning Curve Theory

One important method utilized in estimating the total unit production cost of a program involves the theory of learning curves. Simply stated the learning curve theory is that as the total quantity of units produced doubles, the cost per unit decreases by some constant percentage. Graphic examples of this learning curve effect are presented in Figure 12.

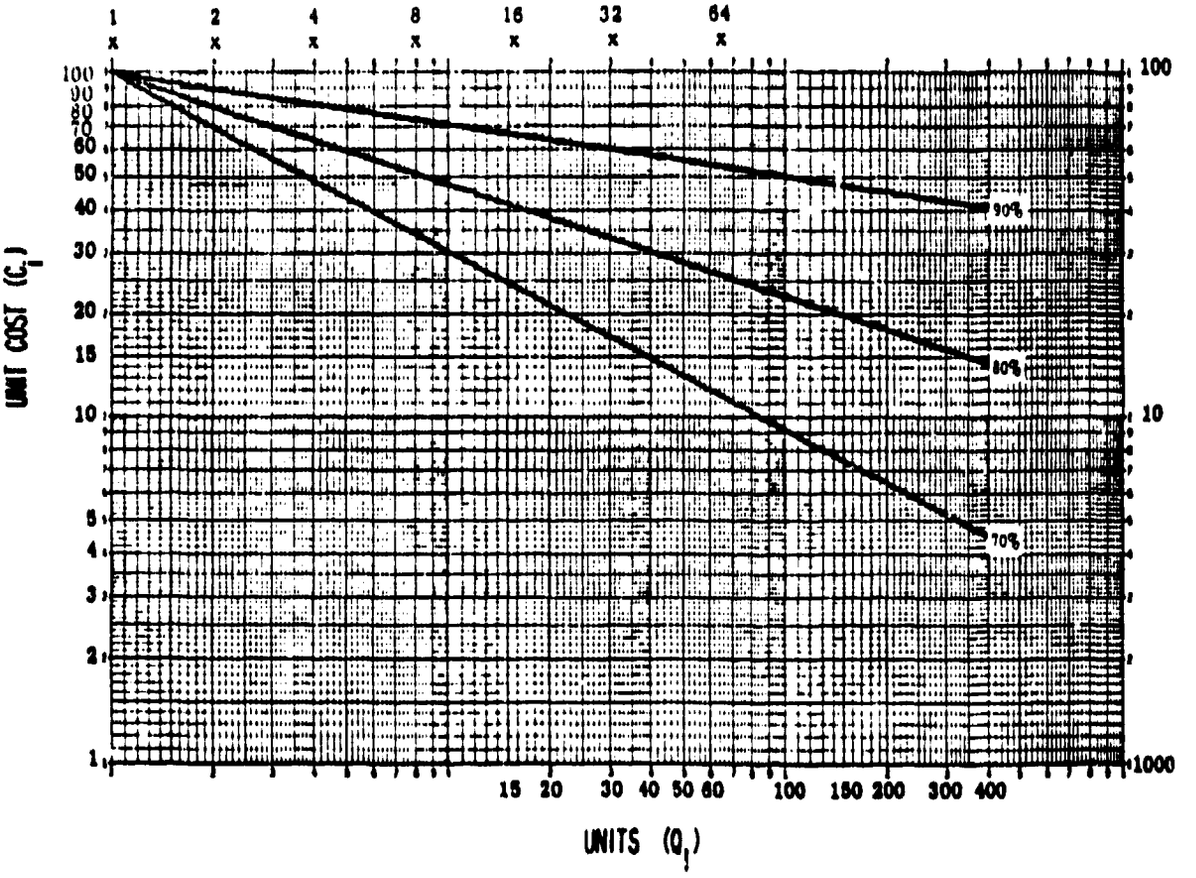

Figure 12. Learning Curves-Unit Cost-Quantity Relationships

This figure shows the cost of subsequent units of production given learning curves (which plot as straight lines on log-log paper) with "slopes" of 90 percent, 80 percent and 70 percent. Consider the learning curve with the 80 percent "slope." An 80 percent "slope" learning curve is one in which the product cost after a doubling of quantity would be 80 percent of the former cost. As an example, since the 10th unit produced cost approximately $47.50 then we would expect the 20th unit to list for approximately 80 percent of $47.50 or about $38.00.

More generally, the unit learning curve theory is of the form:

$$C_i = A_1 Q_i^B$$

Where C_i represents the cost of the unit number i.

A_1 represents the theoretical cost of the first unit, and

$$B = \frac{\ln (\text{Learning Curve "slope"})}{\ln 2}$$

Where the slope is expressed in decimal form. [23: 2028-2029]

This learning curve equation tells how learning (as measured by performance of a task) progresses over time

as the number of opportunities for performing the task increases. Learning increases rapidly at first as obvious inefficiencies are identified and corrected and the basic task is mastered. But, as time progresses, and more and more units have been produced, the rate of learning decreases and approaches an asymptote. This is easier to see on an arithmetic plot as in Figure 13.

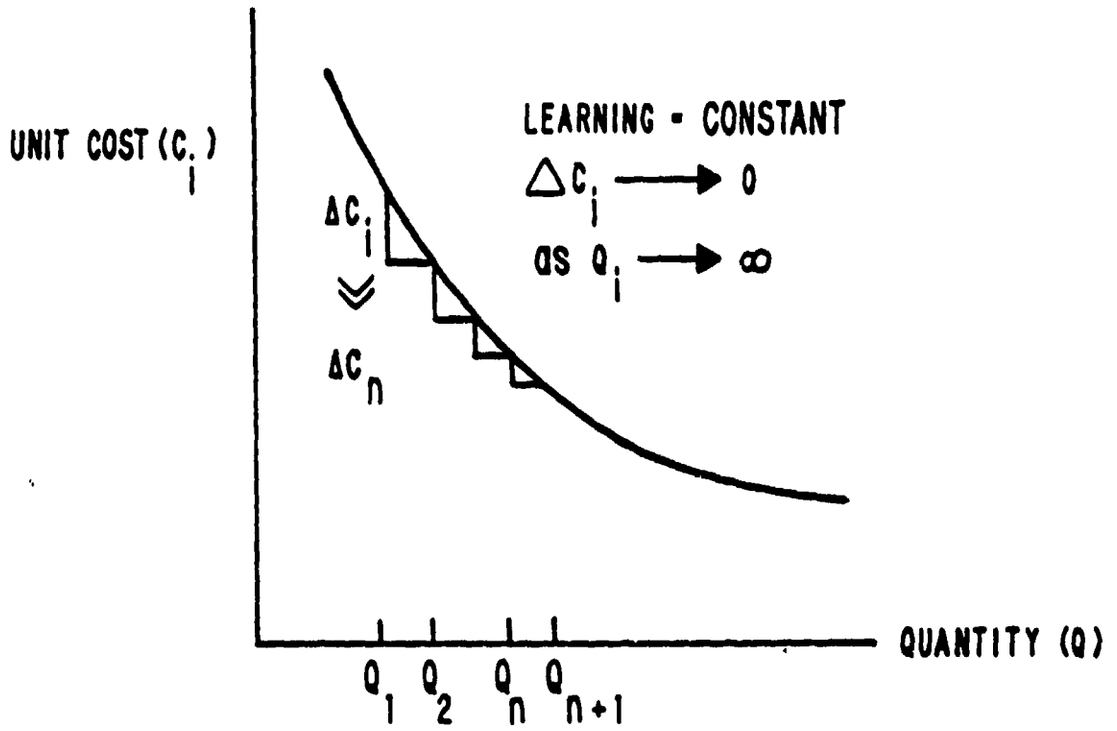

Figure 13. The Learning Curve-Arithmetic Plot

It is important to realize that the learning leading to those cost reduction in a manufacturing process is attributable not only to direct workers (dexterity) but also to management action (e.g. work simplification and engineering changes). [23: 2025-2026]

b. Theory Development

The learning curve theory was developed by T. P. Wright during the 1930's and was applied by the aircraft industry during World War II. The theory provided a much improved method of predicting cost, estimating manpower requirements, and setting prices [24: I-1-I-11].

Two factors found in the aerospace industry seem necessary for successful application of the theory. These factors include, first, the building of a sizable, complex end-item that requires a large number of direct labor hours, and second, production in which unmechanized assembly operations predominate. These factors and the theory in general were validated by a Stanford University study of United States Aircraft production history in World War II. [23: 20-28]

c. Theory Application

Identification of the proper "slope" and the theoretical cost of the first unit (A_1) are complex problems when one uses the learning curve theory to estimate production cost. The expected "slope" is usually derived from a company's previous experience with similar items or components. The proper A_1 is more difficult to decide upon because the real

first unit of a complex item will probably be a prototype model used in ironing out design problems. As such the cost of this real first unit will be unrealistically high. Therefore, the theoretical cost of the first unit should not be that of this prototype model but that of the first true production unit. [24: VII-2]

3. Engineering Changes

One of the foremost concerns of any program manager is controlling engineering changes. An engineering change is any alteration in the physical or functional characteristics of a system or item delivered, to be delivered, or under development after establishment of such characteristics. [1: A-7] Such changes may include the addition of new work, the deletion of work, or the modification of work currently specified. These changes are generally considered to add to weapon system cost. Certainly, after completion of planning for, and installation of, a production process any change will at least initially prove organizationally dysfunctional. (For example, changing even a simple process may require a major industrial engineering effort to rebalance an assembly line.) Archibald, in his widely read Managing High-Technology Programs and Projects, discusses the need to firmly establish a design freeze point to suppress dysfunctional change [7: 190].

However, freezing the design of a major weapon system is very difficult if not impossible. Perhaps the best a program manager can hope to do is "rigidly control" engineering

changes. The literature discusses engineering change at great length; most often offered as causes of engineering changes are the following:

- Bringing system performance up to expected standards.
- Incorporation of advances in the state of the art.
- Concurrency.
- Striving for technical perfection.
- Buy-ins.

a. Bring System Performance up to Expected Standards

The operational and technical characteristics of a weapon system are formalized at DSARC II and are reported as goals in the SAR. But what happens during the development, test and evaluation phases when the performance demonstrated falls short of those goals? The program manager is faced with two choices: First, expend resources to improve the system so that it will meet or at least come closer to those goals, or sell the user organization on the fact that the demonstrated performance is "good enough."

The question of whether to expend more resources in search of better performance is usually addressed in a cost-benefit analysis context [25: 25-26]. Consider Figure 14 as an example of Cost-Benefit (Performance) analysis of improving maximum airspeed of a tactical airplane.

If the maximum air speed demonstrated during flight test is a_1 knots and a large improvement can be generated by expending $\$\Delta X$, then it may be wise to suffer the

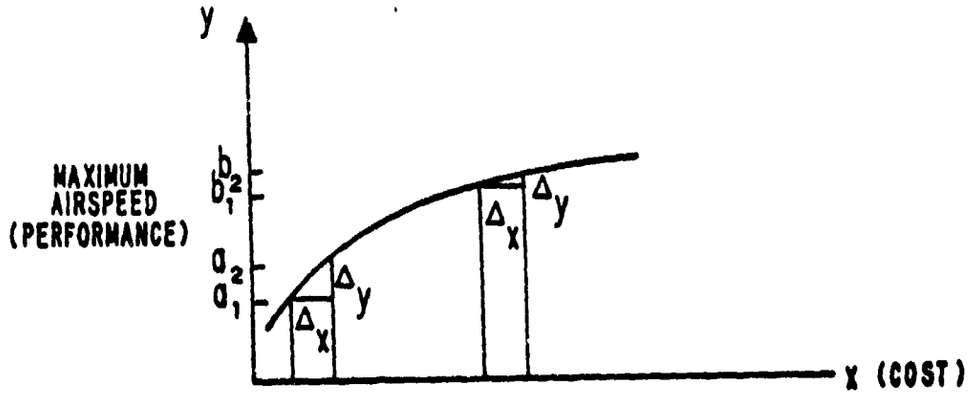

Figure 14. Cost-Benefit Curve

cost growth required to obtain the performance goal a_2. That is, the ratio of the added Benefit (Performance) to cost $\frac{\Delta Y}{\Delta X}$ is attractive. However, were the demonstrated performance to be b_1 knots and the goal b_2 knots, the analysis would be much less favorable. In this latter case only a small improvement in performance (ΔY^1) would be returned for expending $\$\Delta X$. Is that little bit of added performance really worth the cost growth that would be suffered? That is a nontrivial problem. If this higher performance level (b_2) is required to win the air battle that would be one thing, but how was this level determined and specified?

Charles J. Hitch, Assistant Secretary of Defense (Comptroller) speaking at the University of California, Berkeley, in 1965 stated, "Suspicion persists in some influential quarters that somehow or other cost-effectiveness (another name for Cost-Benefit) studies put dollars before national security." [26: 38] But, Hitch goes on to point out:

> To anyone trained in economics, this is a most puzzling attitude. We know that the very act of making a choice--and that is all we are doing--involves weighing the utility or benefit to be gained against the cost which must be incurred. Why is that so? It is so because benefits "cost" resources and we live in a world in which resources are limited. If we use more for one purpose, less remains for other purposes--even in as rich a nation as the United States. [26: 38]

b. Incorporation of Advances in the State of the Art

There is a decreasing lag time between the discovery and application of scientific knowledge. Hence, it is not unusual for weapon system developments extending over a number of years to have the opportunity (sometimes the necessity) to embrace new technology offering large increases in capability. A new Navy submarine, approved as of the summer of 1956, called for building a missile based on performance characteristics attainable in 1958 to be used with the submarine scheduled to be ready for service in 1965. As the program progressed it became apparent that newer solid-fueled ballistic missile technology offered the Navy far greater capabilities. That new missile, named the Polaris, was to resist obsolescence well into the 1970's. To have

resisted incorporation of more advanced state of the art technology in the name of cost control would have been to produc a system that was outdated prior to commissioning. [27: 30-31]

c. Concurrency

Department of Defense Instruction 5000.2 charges program managers with the objective to achieve initial operational capability within the time dictated by the need or threat [10: 12]. One of the recommended ways to meet this schedule goal is with planned concurrency. Concurrency is defined as overlapping, combining, or omitting phases of the acquisition process. With the F-18 program, for example, the Navy has practiced concurrency by simultaneously conducting flight testing and proceeding with initial production. Even though the flight test program identified performance problems that required correction via engineering changes, the Navy adhered to its tight program schedule. [28: 12]

Mr. David Packard, while Assistant Secretary of Defense, condemned currency, saying, "Engineering changes that are made on the production line are costly and wasteful. They generate waste, real waste, as you all know right down through the subcontractor structure." [29: 23-24] One can accept Mr. Packard's argument that concurrency leads to waste, or one can view the cost growth that concurrency precipitates as the price paid for timeliness.

d. Striving for Technical Perfection

An unidentified program manager has been quoted as saying: [30: 35]

> Design engineers will fiddle and tinker forever. If you let them alone, you are guaranteed to have schedule slippages and cost growth problems. Nothing will come out of the end of the pipe unless you push it out.

Such a comment does not set well with many engineers, including this writer. Engineers recognize that cost and schedule as well as technical requirements are inputs into the design equation. Establishment and maintenance of cost and schedule constraints are however, management, not engineering responsibilities. But, if engineering changes are approved by management purely in search of unrequired technical betterment unwarranted cost growth and schedule slippage will result [30: 27]

e. Buy-ins

It is conceivable that a contractor might deliberately underbid to get a contract and then overestimate the cost involved in incorporating engineering changes in order to recoup losses. This phenomenon is known as a buy-in and is an emotional issue with government contracting officers. A Naval Postgraduate School contract management professor states that contractor buy-ins are a serious problem.

Padgett reasoned, in his statistical study of defense contracts, that if underbidding was a factor in cost overruns, then the type of contract should have some effect

on the degree to which it occurs [31: 56]. That is, firm fixed price contracts should have the smallest overruns because there is an inherent penalty for overruns and a reward for underruns. On the other hand, cost plus fixed fee contracts should have the highest overruns since there are no explicit penalties for overruns or reward for underruns. The results of Padgett's regression analyses were generally inconclusive (i.e. not statistically significant) [31: 101].

This researcher has been unable to locate any quantitative research which statistically supports buy-ins as a serious problem on weapon system cost overruns.

f. Cost Reduction

Not all engineering changes contribute to cost growth; some changes result in cost reductions. The literature discusses engineering changes designed to reduce cost primarily in relationship to design-to-cost contracts.[6]

The Government Accounting Office has expressed the concern that, with the introduction of design-to-cost goals, engineers will vector more of their attention to reduction of production cost and less toward technological innovativeness. [32: 12] This could, they say, slow the pace of major technological breakthrough.

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[6]"Design to Cost" is a management concept wherein rigorous cost goals are established during development, and the cost control of systems cost to these goals is achieved by practical trade-offs between operational capability, performance, cost and schedule. [1: A-6]

The General Accounting Office observes in the same report that many systems have been designed with growth potential by providing more space than needed at first. Often times improvements made later in the system life cycle were made at relative low cost by taking advantage of the overdesign. [32: 11] However, if this overdesign is sacrificed to maintain design to cost goals, later system modifications will have to be made at a higher cost. The result could be a net increase in life-cycle cost.

4. Contract Types

One of the major techniques available for program cost control is the wide variety of available contract types. In aggregate there are basically two types of contracts which a program manager may employ: fixed price contracts and cost-type contracts.

Lee and Dobler identify some important factors that influence contract type selection: [33: 116]

- The intensity of competition among vendors.
- The vendor's cost and production experience in manufacturing similar items.
- The availability, accuracy, and reliability of pricing data.
- The extent of the business risk involved.

The fixed price type contract maximizes the possible profit which a contractor (producer) can earn, but also maximizes his risk. From the buyer's point of view this type

of contract offers low risk and minimum administrative requirements and motivates the contractor to produce efficiently. [33: 117].

On the other hand, cost-type contracts are used when it is impossible or unfair to arrange fixed-price contracts. Here the buyer assumes the financial risk and the contractor agrees only to give his best efforts to complete the contract within the estimated cost provided in the contract. With cost-type contracts, however, the contractor is under no further obligation if, despite his efforts, the material or service contracted for is not fully provided at the time he expends all the funds in the contracts. [11: 3-36]

a. Acquisition Phases and Contract Types

The Navy Program Manager's Guide discusses contract types in relation to acquisition phases [11: 3-38-3-39]. This guide recommends fixed price type contracts during the concept exploration phase (DSARC Phase 0) because the product (a paper report) is clearly established and because this type contract provides the only means of putting competing contractors on equal footing. The guide cautions, however, that the contract dollar amount for Phase 0 should be sufficient to pay for the work requested, less contractors spend their own funds in an attempt to "buy-in."

The guide recommends fixed-cost type contracts also for the Demonstration and Validation Phase (Phase I) for the same reasons as those presented for Phase 0. The argument

is that even though potential uncertainties (and therefore risk), are greater, equally funded competition overrides such risk.

During the full-scale development phase (Phase II) it is recommended that a cost-type contract should be used. The justification offered is that the Government must have the flexibility to make decisions with regard to technical uncertainties so as to achieve the best cost-performance-schedule compromises. The expected costs of corrections brought about by these technical uncertainties are always fuzzy at the outset of Phase II and, correctly, a portion of the risk should be borne by the Government.

Once the full development phase is completed, and the design is firmly established, a fixed-cost type is in order.

b. Fixed-Price Contract Types

Types of fixed-cost contracts include:

- Firm Fixed Price (FFP) - The buyer agrees to pay a specified price to the seller when the latter delivers what was purchased. [33: 117]
- Fixed Price with Escalation (FPE) - A FFP type contract except an escalation clause provides for either an upward or downward change in price as a result of changes in either material prices or labor rates relative to an economic index. [33: 117]

- Fixed Price with Redetermination (FPR) - A Contract where the amounts of labor and material are initially unknown but can be determined with limited production. A buyer contracts for a temporary price he believes to be high but receives protection from still higher prices. After an agreed-upon percentage of work has been completed at the temporary price, the contract price is redetermined based upon data from production to date. The buyer expects the redetermined price will be lower (perhaps because of learning or expected future volume). [33: 118]
- Fixed Price Incentive (FPI) - The FPI is a variation of a redeterminable type contract designed to incentivize production efficiency via a target price, a ceiling price and variable profit formula. [33: 118]

c. Cost Type Contract Types

A listing of cost-type contracts includes:

- Cost Plus Incentive Fee (CPIF) - This type is a variation of an FPI type contract where buyer and seller agree beforehand on a tentative fee based on estimated cost. If the seller can reduce costs below the agreed upon estimated costs, buyer and seller share the reduction. Regardless, all costs are paid by the buyer. [33: 121]
- Cost Plus Award Fee (CPAF) - This type is an offshoot of a CPIF Contract wherein the fee consists of two parts: a fixed amount which does not vary with contract performance, and an award amount intended to be sufficient to

provide motivation for excellence in contract performance in areas such as quality, timeliness, ingenuity and cost effectiveness. [33: 121]

- Cost Plus Fixed Fee (CPFF) - A contract type that provides the seller with reimbursement for all allowable costs up to a stated amount, plus a fixed fee calculated as a percentage of the originally estimated cost. [33: 120]

d. Risk as a Function of Contract Type

By way of summary, Figure 15 depicts the relative risk assumed by the government and the contractor as a function of contract type.[6]

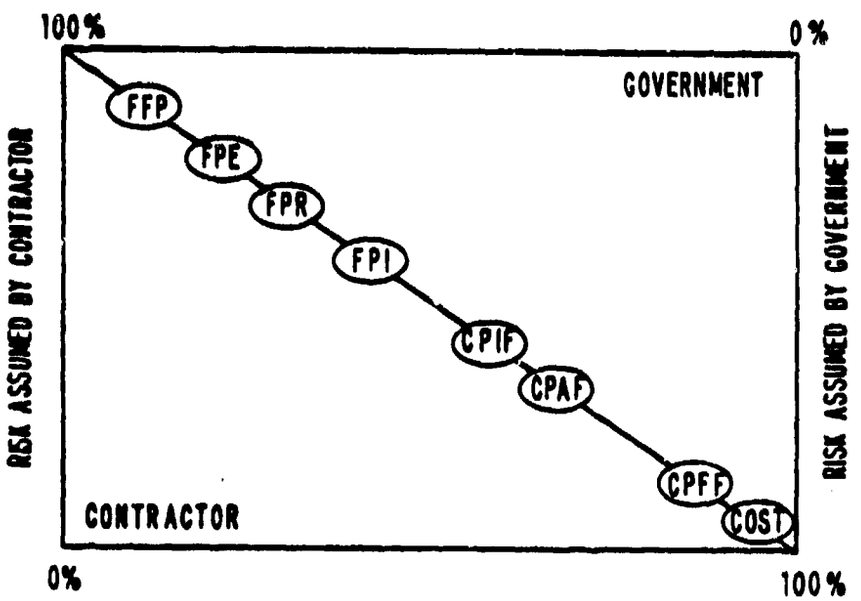

Figure 15. Degree of Risk as a Function of Contract Type

[6]This figure was adapted from the Navy Program Manager's Guide. [11: 3-37]

C. INFLATION AND MEASUREMENT OF INFLATION

This section defines and discusses several current theories of inflation. Next, the development and history of index numbers are presented along with an example of their use to determine the base year value of a series of multi-year outlays. Lastly, a price level index peculiar to the aerospace industry is discussed.

1. Inflation

Inflation is feared by all, criticized by most, and not clearly understood by any. Samuelson defines inflation as "...a time of generally rising prices for commodities and factors of production." [34: 301]

The traditional concept of inflation centered around the theory of excess total demand. This "Demand-Pull Theory" states that if the economy is operating at full-employment then the total output if fixed. Any excess demand will necessarily have the effect of pulling up the price level. The demand pull theory was widely accepted until the 1957-58 recession, when economists were embarrassed to find that employment and output were declining at the same time general price levels were rising. [35: 384] This paradox gave rise to two newer theories "cost-push inflation" and "structural inflation." [35: 385]

The cost-push inflation theory maintains that inflationary pressures are a function of unions and businesses. Unions and businesses both possess significant degrees of

market power and therefore can manipulate wages and prices independent of overall total demand. This theory maintains that the unions are sometimes the villains with their demands for higher wages pushing up costs which are passed along to consumer. Other times, businesses are the villains because they misuse their power to increase prices when the increases are not justified by increased costs.

Structural inflation theorists believe that inflation results from a change in the structure, though not the size of total demand. Briefly stated, this theory maintains that the market power of businesses (prices) and of unions (wages) tend to be flexible upward but inflexible downward.

An inflationary theory which currently has a large following is the "monetarist theory." Monetarists contend that the quantity of money is the prime determinant of economic activity. More specifically, they maintain that this quantity is controlled by Federal Reserve Board actions. Aggregate supply depends on factors such as: available inputs of labor, capital, raw materials, the state of technology, and crucially on the incentives to put these means to work.

Prices then, the monetarist theorize, depend on the ratio of money to output. When money grows faster than output, aggregate demand exceeds aggregate supply, prices and interest rates rise and inflation results [36: Editorial Page]. The monetarist view is supported by the historical correlation between changes in the money supply and inflation as depicted in Figure 16.

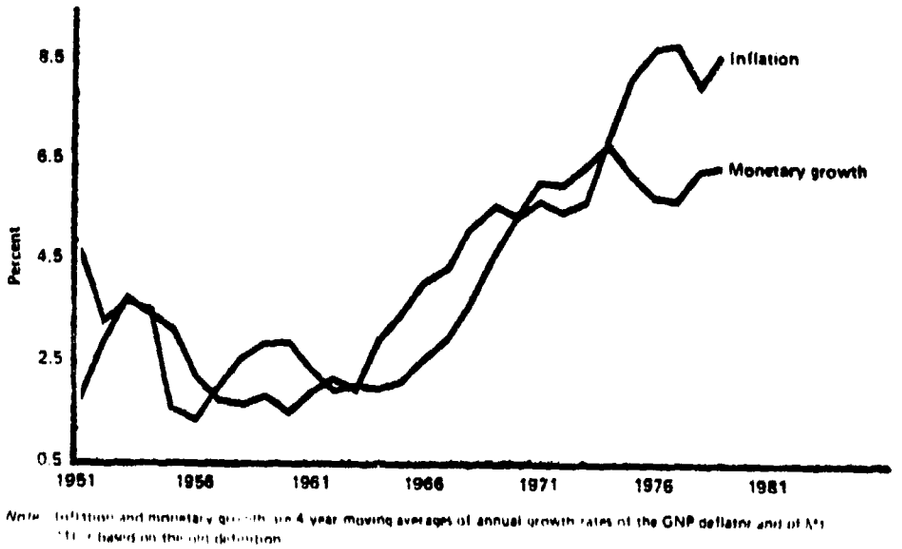

Figure 16. Inflation and Monetary Growth

Inflation has adversely affected defense acquisitions throughout history. During the American Revolutionary War the Continental Congress did not have adequate taxing authority to conduct a major war effort. Consequently, the Congress financed the Revolution by printing paper money known as "Continentals." The first issuance was limited to three million dollars and was to be redeemed in exchange for Spanish silver dollars after the successful conclusion of the war. By 1779, however, approximately 200 million dollars of paper currency had been issued. General George Washington wrote in that same year, "A wagon load of money will scarcely purchase a wagon load of provisions." [37: 138-142]

The impact that inflation can have on a modern weapon system will be addressed in the next subsection.

2. Index Numbers

The use of index numbers grew from the necessity to relate the values of real assets from one period to another during times of inflation. In olden times when the local king debased the silver coinage by minting coins that were 50% silver and 50% some other metal without any value the mathematics were simple; it would take two new coins to equal one old coin.

In today's complex economy things are not as simple. The modern study of index numbers dates back to 1800 and draws from both statistics and economics. The formulas and proofs for weighting methods used today were presented by Laspeyres (1864) and Paasche (1874). [38: 652-655]

a. Index Numbers and Program Budgets

To see how index numbers are used in analyzing and managing program budgets, consider a hypothetical series of Appropriations for Research and Development of the X-99 airplane presented in Table 1. All funds appropriated for research and development of the X-99 will not be expended during the year they become New Budget Authority but will be actually spent (outlaid) over a number of years. A visual model, Figure 17, may make this more clear.

Assume that the complete appropriated budget authority and annual outlays will be as indicated in Table 2.

TABLE 1

APPROPRIATIONS FOR THE (HYPOTHETICAL) X-99 AIRPLANE

1990	$1,500 million
1991	1,800 million
1992	1,400 million

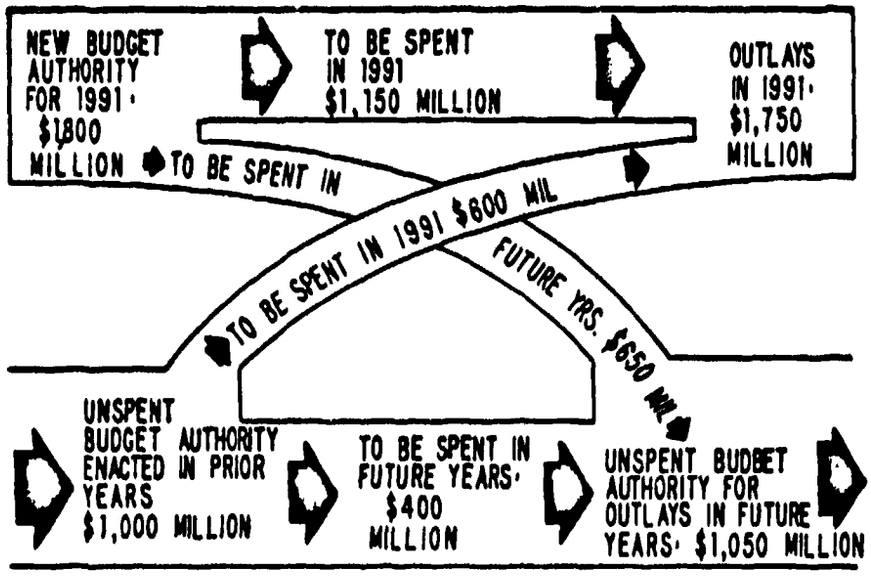

Figure 17. Budget Authority and Outlays

TABLE 2

X-99 APPROPRIATIONS AND OUTLAYS

APPROPRIATED NEW BUDGET AUTHORITY	OUTLAYS (MILLIONS)						
	1990	1991	1992	1993	1994	1995	TOTAL
1990=$1,500 mil	500	600	400				1,500
1991=$1,800 mil	-	1,150	350	200	100	-	1,800
1992=$1,400 mil	-	-	1,000	150	150	100	1,400
TOTAL THEN YEAR DOLLARS	500	1,750	1,750	350	250	100	4,700

If there were zero inflation in the aerospace industry in the years 1990 through 1995, the "total then year dollars" row would accurately reflect the value of resources expended in each respective year. However, a more realistic situation assumes the annual rates of inflation shown in Table 3.

TABLE 3

ASSUMED ANNUAL RATES OF INFLATION

Annual Rates of Inflation in Aerospace Industrial (Hypothetical)	
1990	0.0%
1991	2.5
1992	4.2
1993	8.4
1994	7.3
1995	8.0

Now, because of inflation, the 1990 appropriated dollars did not buy a full 1,500 million dollars worth of goods, but bought less because the dollars expended in 1991 and 1992 were of less value than they were in 1990. How much purchasing power was lost? In developing an answer to the question look first at the number of additional dollars that would be required to offset inflation each year during the period of interest. Remember that inflation has a compounding effect.

Generally,

$$\$_t = \$_o(1+I_1) \times (1+I_2) \times \ldots \times (1+I_n)$$

where $\$_t$ = the number of dollars required in year t to equal the purchasing power of $\$_o$ Base Year Dollars

$\$_o$ = Base Year Dollars

$I_1, I_2 \ldots I_n$ = Annual inflation rate for each year t

Applying the above formula to the example at hand, 1.025 of the 1991 dollars would be required to equal the purchasing power of one 1990 dollar; according to:

$$S_t = \$_o(1+I_{1991})$$

$$\$_{1991} = 1(1+0.025)$$

$$\$_{1991} = 1.025$$

This is a price level index number. Likewise 1.068 of the 1992 dollars would be required to equal the purchasing power of one 1990 dollar:

$$\$_t = \$_o(1+I_{1991}) \times (1+I_{1992})$$

$$\$_{1992} = 1(1+0.025) \times (1+0.042)$$

$$\$_{1992} = 1.068$$

A complete listing of price level index numbers for the years of interest is presented in Table 4.

TABLE 4

ASSUMED PRICE LEVEL INDEX (PLI) NUMBERS

	Hypothetical Price Level Index (PLI)
Current Year	Number of current (then year) dollars required to equal the purchasing power of one 1990 dollar. [$t/$1990]
1990	1.000
1991	1.025
1992	1.068
1993	1.158
1994	1.242
1995	1.342

The information need to convert from the "then Year" (current) dollars to an equivalent value of "base year" dollar (or vice versa) has now been developed.

That is:

$$\$_o = \frac{\$_t}{PLI_t} \text{ or equally, } \$_t = \$_o \cdot PLI_t$$

Where $\$_t$ = (as before)

$\$_o$ = Base Year (constant) Dollars (i.e. the Year where $PLF_t = 1.000$)

PL_t = Price Level Factor for the year t (i.e. the number of current (then year) dollars required to equal the purchasing power of one Base Year Dollar)

Returning to the data presented in Table 2 on outlays, and applying the methods developed, these data can now be deflated and expressed in terms of constant dollars; that is, in 1990 Base year dollars.

For example, the $400 million of the 1990 appropriation outlaid in 1992 had a value of $374.53 million in terms of constant 1990 dollars, according to:

$$\$_o = \frac{\$_t}{PLI_t}$$

$$\$_{1990} = \frac{\$_{1992}}{PLI_{1992}}$$

$$\$_{1990} = \frac{\$_{400\ million}}{1.068} = \$_{374.53\ million}$$

Inflation ate away (400.00 - 374.53=) $25.47 million.

Reconstructing Table 2 in terms of constant 1990 dollars yields Table 5.

Whereas $4,700 million "then year" dollars were appropriated for research and development of the X-99 airplane, this amounted to only $4,423.94 million when expressed in terms of constant 1990 dollars. There were ($4,700 - $4,423.94=) $276 million lost because of the multiyear spending pattern during inflationary times.

In the development above the annual inflation rate was given and the price level indices were constructed using the assumed annual inflation rates. In reality the measurement of the changing purchasing power of money is a complex and difficult problem.

TABLE 5

X-99 APPROPRIATIONS AND OUTLAYS (INFLATION ADJUSTED)

	Outlays (millions) Constant 1990 Dollar						
Appropriation	1990	1991	1992	1993	1994	1995	Total
1990 ($\$_{1990}$=1,500 mil)	500.00	585.37	374.53				1459.90
1991 ($\$_{1991}$=1,800 mil)		1121.95	327.72	172.71	80.50		1702.89
1992 ($\$_{1992}$=1,400 mil)			936.33	129.53	120.77	74.52	1261.15
Total 1990 Base Year Dollars	500.00	1707.32	1638.58	302.24	201.28	74.52	4423.94 / 4423.94

How would one measure inflation? One way would be to define a "market basket" of goods and services and calculate the money required to purchase the goods and services in the market basket. At some later time one could again purchase a market basket containing identical or similar items, and by comparing the amount of money paid at those two points in time have a measure of inflation. This is just what Laspeyres and Paasche proposed. They differed, however, in the manner by which they weighted their market baskets.

b. Laspeyres Index

Laspeyres proposed to compare the prices of the base year's market basket of goods, to the current prices of that same market basket. [38: 625-635] That is:

$$\frac{\sum P_t Q_o}{\sum P_o Q_o}$$

Where P_t = the current price of a good in the market basket.

P_o = the base price of a good in the market basket.

Q_o = the base quantity of that good in the market basket.

However, there is a problem. The rational consumer will not buy the same market basket of goods and services when prices are changing relative to each other. He or she

would adjust the composition of the basket to contain more of the less expensive items and less of the more expensive items. Considering the producer of the hypothetical X-99 for a moment, in times of increasing costs of labor, but stable or decreasing cost of capital, the manufacturer would shift production toward a less labor intensive mix. Laspeyres indices do not consider these dynamics of the market and may be thought of as a comparison of a hypothetical market basket ($\sum P_t Q_o$) to an actual market basket ($\sum P_o Q_o$). Consequently, during periods of generally increasing prices, Laspeyres indices generally are considered to overstate the level of prices in periods other than the base period. The Consumer Price Index (CPI) and the Producer Price Index (PPI) are of the Laspeyres type.

c. Paasche Index

On the other hand, Paasche proposed to compare market baskets filled with current quantities of goods and services purchased at base year prices and current prices, that is: [38: 625-655]

$$\frac{\sum P_t Q_t}{\sum P_o Q_t}$$

By the same logic as before this is a comparison of an actual market basket ($\sum P_t Q_t$) to a hypothetical market basket ($\sum P_o Q_t$). It follows that during periods of generally

increasing prices a Paasche index would tend to understate the level of prices in periods other than the base period. The Gross National Product Deflator (Index) is of the Paasche type.

3. Aerospace Price Indexes

It is generally believed that an index developed around a specific industry or product type would provide a better explanation of, and would be a better predictor for, inflationary price movement within that specific industry or product than a general, "economy-wide" index such as the PPI.

Campbell (in a 1970 Rand Corporation Study) developed a methodology for constructing an index specific to the aerospace industry, which the Department of Defense has generally embraced [39: 1-22]. Campbell's "market basket" contains aerospace products and he developed his index (Laspeyres type) using the prices of materials, parts, and the wages of the aerospace workers that went into producing those products.

The advantage of an index specific to the aerospace industry can be seen in the following example. Aircraft engines use a large amount of the metal nickel, and the price of nickel has greatly increased during the last year. The cost of aircraft engines reflects this increased metal cost. Only an index that considers the weighted impact of the cost increase of nickel (and other specific materials) can accurately reflect the impact of inflation on aerospace products.

Some caution is well advised, however. An index specific to the aerospace industry at large may not be representative of the "market basket" of materials, parts and labor required to produce a particular airplane. Additionally, Padgett, in his 1975 study, challenged the effectiveness of aerospace indexes because most use wholesale price index data weighted only for materials and labor [31: 103-107]. He points out that, "the WPI (now called the PPI) does not reflect the full effects of inflation in that no allowance is made for discounts, credit terms, interest rates, capital cost and changing overhead rates due to changes in the level of business that may accompany a rising rate of inflation."

D. CHAPTER II SUMMARY

The intent of this chapter was to survey pertinent literature in support of the research which will be reported in Chapter Three. Additionally, an attempt was made to collect and summarize this multi-disciplinary literature into a form convenient for reference by program managers.

The first section of this chapter addressed the program management and acquisition environment. The program management concept was described as the central organizational mechanism for integrating research, development, test and evaluation efforts. The central tenet of program management was seen to be organization by purpose. The acquisition environment was discussed in terms of the Defense Systems Acquisition Review Council (DSARC) and the Planning, Programming,

Budgeting System (PPBS). The DSARC was observed to be a "technical event oriented" control system which does not provide acquisition funding. PPBS was seen to be a "periodic" or "time" oriented system which does provide acquisition funding. It was noted that funding delays could be experienced if DSARC milestones were completed out of phase with the PPBS. The Selected Acquisition Report (SAR) was regarded as the standard, comprehensive summary status report on major defense acquisition programs.

The second section of this chapter covered program management methods, concepts and techniques in acquisition programs. First cited were program cost estimation methods. Parametric and industrial engineering methods were addressed, as were sources of estimating errors. A case was made for communicating cost estimates as "confidence intervals" versus "point" estimates so as to relate uncertainties encountered in estimate formulation. Next the theory of learning curves was presented as a method utilized in estimating the cost of units produced as a function of production experience. Generally, this theory holds that as the quantity of units produced doubles, the cost per unit decreases by some constant percentage. Then, engineering changes were noted to usually lead to increased program cost. Causes of engineering changes discussed included: (a) bringing system performance up to expected standards, (b) incorporation of advances in the state of the art, (c) concurrency, (d) striving for technical perfection,

and (e) buy-ins. An economic defense of cost-benefit analysis was offered when discussing the cost of buying improved performance. Lastly, different types of contracts were explored as a technique for program cost control. Different contracts were visualized on a continuum from fixed-price-type contracts (where the producer assumes the majority of the risk) to cost-type contracts (where the government assumes the majority of the risk).

The third and final section of this chapter concerned inflation and measurements of inflation. Inflation was defined as a time of generally rising prices. Inflation theories discussed were the demand-pull, cost-push, structural, and monetarist theories. The monetarist theory was viewed as being currently widely accepted; this theory maintains that the quantity of the money supply is the prime determinant of inflation. The measurement of inflation was discussed in the context of index numbers. Both LasPeyres and Paasche type indexes were defined. Finally, some caution was advised in use of indexes developed specifically for the aerospace industry because most do not reflect the full effects of inflation.

III. ANALYSIS OF F/A-18 PROGRAM COST GROWTH

The analysis of weapons systems cost growth is complex and requires a knowledge of the program management environment, the methods, concepts and techniques of cost estimation and control, and an understanding of inflation and measurements of inflation. Much of this needed background is provided in the previous chapter.

This chapter analyzes the cost growth experienced in the F/A-18 airplane acquisition program. The following questions are addressed in the subsequent material:

- What is the magnitude of total F/A-18 program cost growth?
- What elements make up the F/A-18 acquisition?
- What accounting control system is utilized to track program cost growth, and how is the system categorized?
- What quantitative effect does failure to recognize actual inflation have on cost growth?
- How much control does the program manager have over cost growth?
- What are possible areas of future F/A-18 program cost growth?

Unless otherwise noted, the source for all data presented in this chapter was the F/A-18 program Selected Acquisition Reports.

Before proceeding, the reader must recall that the latest data utilized in this analysis is as of December 1980. This information cut-off was established because this is the latest

data available which was required to be in agreement with the President's budget submission. This is important because information relating to major changes and large cost growths may not be highlighted until the budget is submitted in request for annual appropriations.

The reader must also realize that it is very early in the F/A-18 acquisition. Only approximately 20 percent of the estimated total program funding base year dollars have been expended. Critics may correctly charge that there is too much uncertainty regarding future military decisions and economic conditions to produce a high confidence estimate of total program cost. However, not unlike an individual trying to decide which house to purchase, the Department of Defense must make assumptions regarding future expectations in order to be able to select among competing alternatives for limited resources. To do otherwise is to stick one's head in the sand.

A. TOTAL PROGRAM COST ESTIMATE

1. Then Year Dollars

A historical tracing of the F/A-18 airplane total program cost estimates, expressed in then year dollars, is depicted in Figure 18.

The total program cost estimate includes all program acquisition costs applicable to the approved program regardless of the program's stage of development.[1]

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[1]The approved program is the set of operational, technical, schedule and quantity requirements reflected in the latest

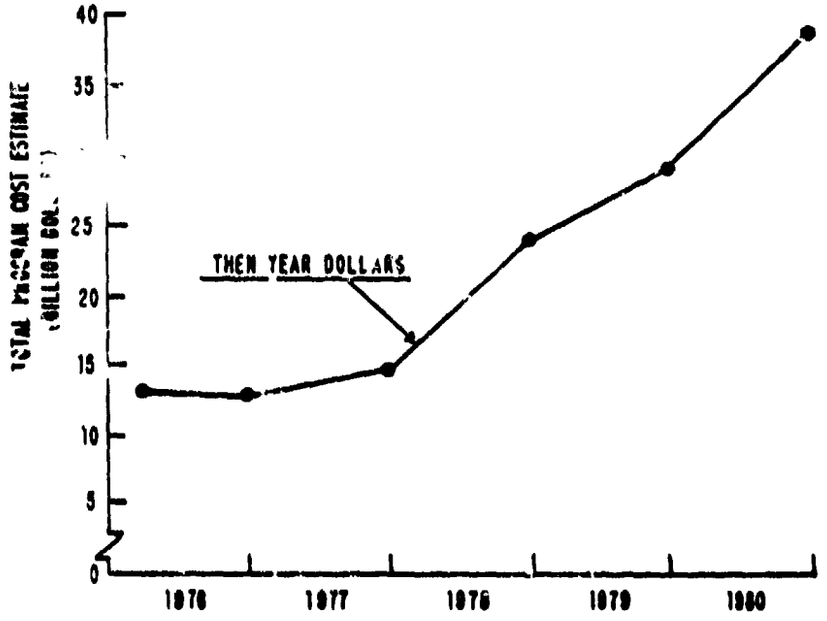

Figure 18. F/A-18 Total Program Cost Estimates--Then Year Dollars

Depicted on the left of Figure 18 is the $12.9 billion development estimate approved at the F/A-18 DSARC II Review of 2 December 1975. This development estimate was published in the March 1976 Selected Acquisition Report and serves as the program base line from which all cost variance is measured. This then year figure is the sum of all the annual appropriations required for the program and reflects assumptions made

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Secretary of Defense Decision Memorandum, or Program Decision Memorandum reflecting a more current decision of the Secretary of Defense [12: 1-3].

by the Office of the Secretary of Defense regarding the expected inflation rates throughout the life of the acquisition program. The [illegible] data points shown on Figure 18 are the current estimates of the total program cost, also in the then year dollars, as they were reported by the program manager in each December Selected Acquisition Report for years 1976 through 1980.[2] The amount by which the current estimate exceeds the development estimate reflects the cost of programmatic and technical changes, the impact of inflation on those changes, and changes in inflation expectations for future years.

The then year dollar, total program cost, current estimate is the figure most often reported in the popular media. These data are quoted by program opponents and congressional detractors. Looking at these data does appear to show an alarming cost growth for the F/A-18 program. The total program cost estimate, which was initially less than $13 billion, has grown to almost $38 billion dollars in just over four years. This may be even more disquieting when one realizes that the F/A-18 is still early in its program life

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[2] A Selected Acquisition Report is published each calendar quarter, but the December SAR's are required to be in agreement with the President's budget submission and supporting documentation, including the FYDP. This requirement means that the December Selected Acquisition Report is the best source of program cost data. Major changes and large cost growths are recognized in the December SAR more so than in SAR's for other quarters.

cycle;[3] and typically cost estimates grow as a program matures.

2. Base Year Dollars

However, since the then year dollar estimates of F/A-18 total program cost contain the effects of inflation, the question quickly arises: What is the total program cost estimate in constant or base year dollars? Stated another way, what is the estimated total cost of the program assuming the purchasing power of the dollar existing in 1975 (when the development estimate was prepared) remained constant throughout the life of the program? To answer this question the data previously reported in Figure 18 are deflated using an index constructed from the Office of the Secretary of Defense projections for inflation.[4] These F/A-18 airplane total program cost estimates, in base year (1975) dollars, are presented in Figure 19. The then year data are reproduced for reference.

The development estimate of total program cost in base year dollars was $8.0 billion. By 1980 the current estimate of total program cost had grown to $15.8 billion

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[3]As of December 1980, only approximately 3.5 billion then year dollars have been actually spent or obligated for the F/A-18.

[4]This process is actually carried out in reverse. That is, one starts with base year dollar estimates and inflates to the year dollars. However, since the reliability of OSD rates will later be questioned, the analysis is presented as starting with then year figures and deflating.

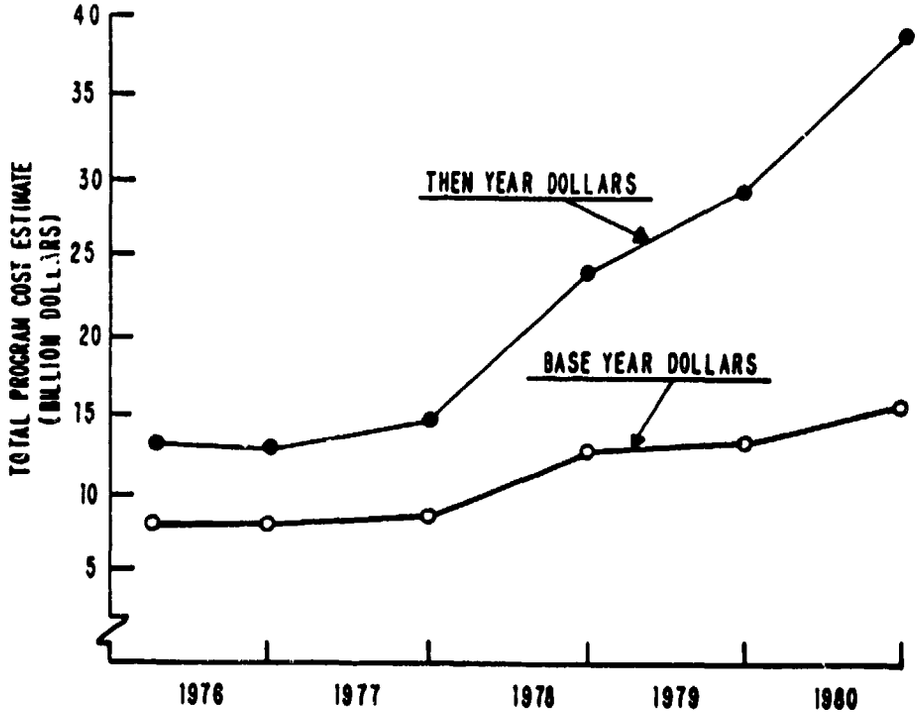

Figure 19. F/A-18 Total Program Cost Estimates Then Year and Base Year (1975) Dollars

base year dollars. Clearly, by comparing the current estimates of then year data and base year data, the reader can observe that much of the cost growth discussed in the popular media is a product of inflation. This is true even when the then year data are deflated using inflation indexes derived from inflation estimates issued by the Office of the Secretary of Defense. (These rates are underestimated as will be discussed later in the chapter).

An enlightening way to look at these same data is presented in Figure 20.

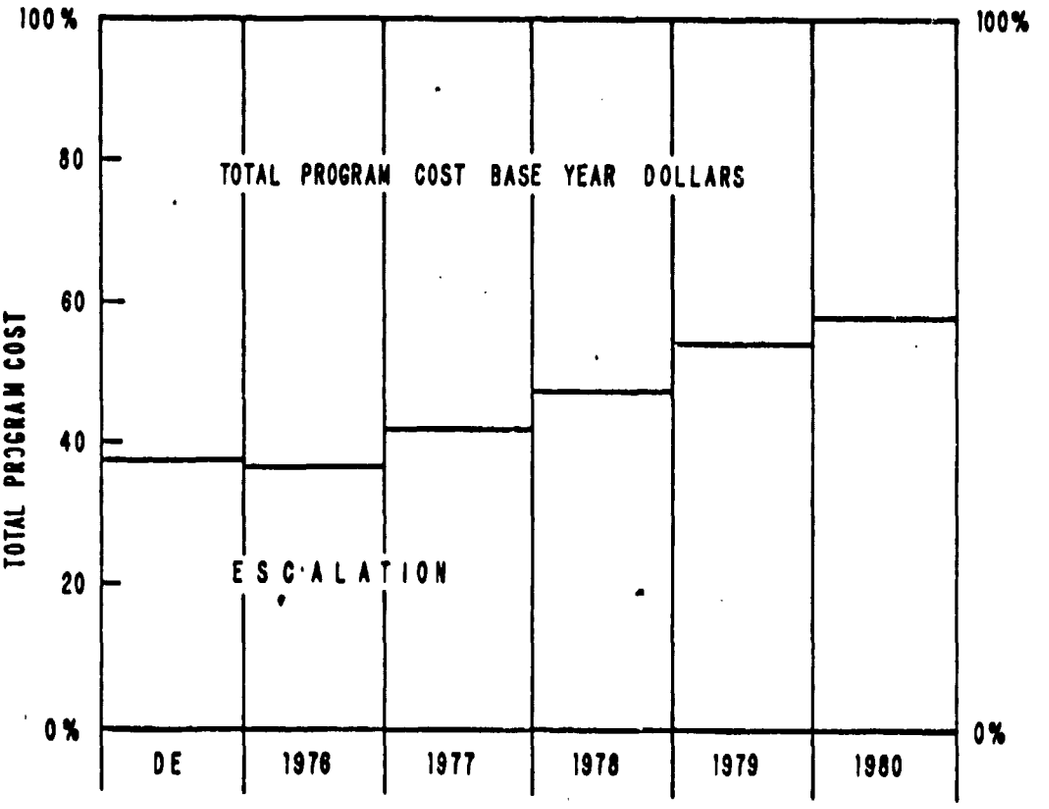

Figure 20. F/A-18 Total Program Cost - A Percentage Analysis of Then Year Cost Estimates

It may be noted that when the development estimate was prepared ($12.9 billion in then year dollars), approximately 38 percent of this total then year dollar estimate represented escalation (the Department of Defense word for inflation) and 62 percent represented the total program cost in 1975 dollars.[5] However, by the end of 1980 escalation

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[5] $12.9 billion - then year dollar estimate of total program cost
- 8.0 billion - base year dollar estimate of total program cost
$ 4.9 escalation

$\frac{\$\ 4.9\ \text{billion}}{\$12.9\ \text{billion}} = 38\%$

amounted to over 58 percent of the then year dollar, current estimate of total program cost. This reflects that while the total program cost was growing in terms of both the base year dollar estimate and in terms of the impact of inflation, the inflationary effects and expectations were growing faster and were constituting a larger and larger percentage of total program cost.

3. Base Year Dollars--Adjusted for Inventory Objective

Deflating the then year, current estimates of total program cost to base year dollars removes one variable (inflation) and makes easier the analysis of the program cost growth. However, there is another variable which clouds a comparison of the development estimate and current estimates reported after December 1978. The development estimate addressed an 800 airplane force, whereas the large cost growth observed in 1978 reflects a quantity change in the program inventory objective to 1366 airplanes.

A case can be made that the inventory objectives (800 airplanes) stated in the development estimate were understated. This will be addressed in the later section on Quantity Variance. However, to facilitate an analysis of the management of the program relative to the development estimate, the cost associated with the additional 566 airplanes (1366 - 800 = 566) is removed. The results are depicted in Figure 21. The then year data and the unadjusted base year data are reproduced for comparison.

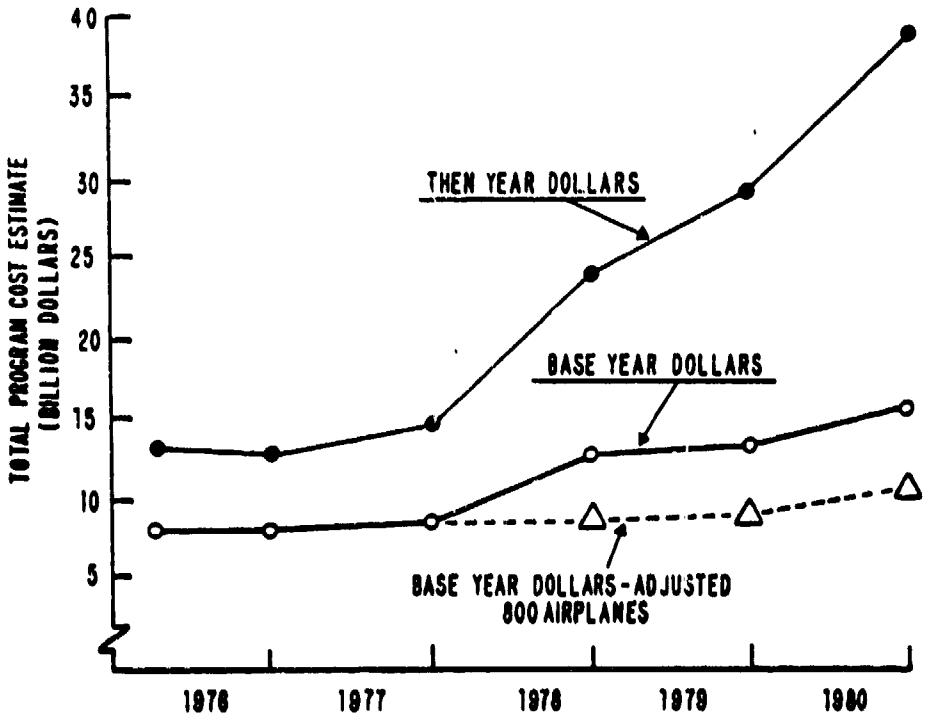

Figure 21. F/A-18 Total Program Cost Estimates Then Year Dollars and Base Year Dollars and Base Year Dollars Adjusted to a Constant 800 Airplane Force

As depicted in Figure 21, the development estimate of total program cost for 800 airplanes is, as previously noted, approximately 8.0 billion base year dollars. When adjusted to an 800 airplane basis, the 1980 current estimate of total program cost is approximately 10.6 billion 1975 dollars.[6] While still significant, these figures do not

[6]This adjustment was made by reducing the 1366 airplane data by subtracting the cost of production airplanes 801 through 1366 based on the development cost-quantity curves and also reducing the support cost associated solely with the additional 566 airplanes. The cost-quantity relationships and the support cost will later be addressed in detail.

generate the alarm felt when observing the total program cost estimates in terms of then year dollars.

4. Magnitude of F/A-18 Cost Growth

The relative magnitude of F/A-18 cost growth may be better analyzed by developing a ratio of the current estimate of total program cost to the development estimate of total program cost. This ratio is presented in Figure 22 for estimates expressed in then year dollars, base year dollars, and base year dollars adjusted to an 800 airplane force.

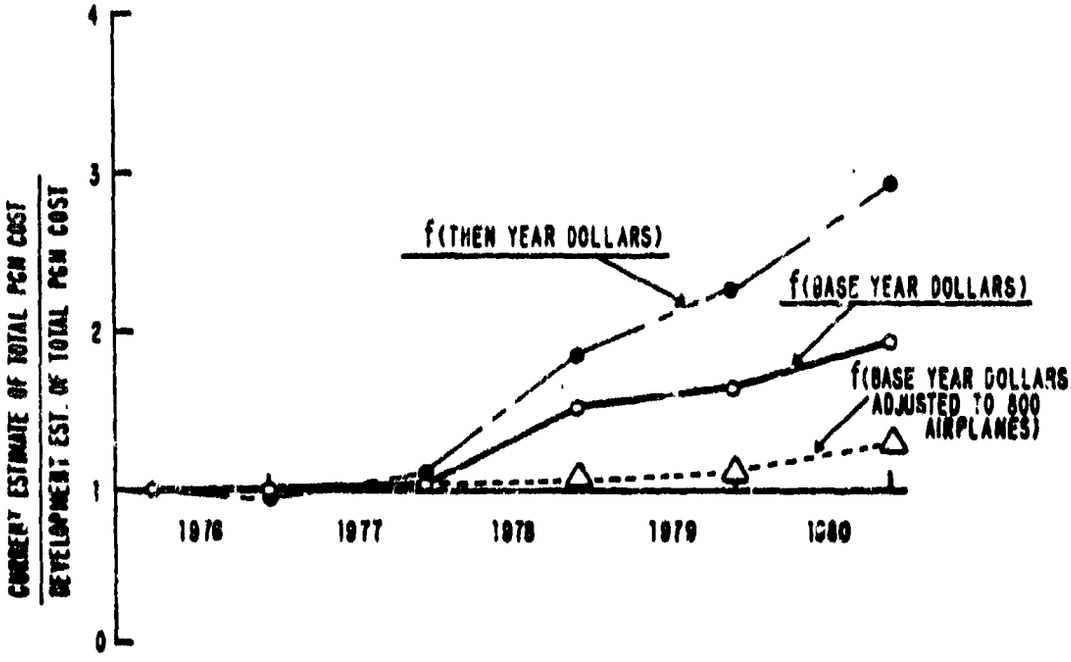

Figure 22. The Ratio of F/A-18 Current Estimates of Total Program Cost to the Development Estimate of Program Cost

As of December 1980 the F/A-18 program cost growth was estimated to be almost 200 percent in terms of then year dollars; almost 100 percent in terms of base year dollars; and just over 32 percent in terms of base year dollars adjusted to consider a constant number (800) of airplanes. (Following a later analysis of the true effects of inflation the magnitude of cost growth will be shown to be actually less than 32 percent).

The "alarming cost growth" expostulated by program critics loses some of its sting when the figures are corrected to make a fair comparison between the development and current estimates.

B. A BREAKDOWN OF TOTAL PROGRAM ACQUISITION COST

So far total program cost has been discussed only in the aggregate without looking at the elements that make up the F/A-18 acquisition. (Program cost and program acquisition cost are synonymous terms.)

Now, the program cost will be broken down and observed to include: [40: 3]

- Development Cost
- Procurement Cost
- Military Construction Cost

1. Development Cost

The development cost includes all research, engineering, test and evaluation costs incurred from the point the

program is designated by title. These costs include those expended during the DSARC conceptual exploration phase (Phase 0), the demonstration and validation phase (Phase I), and the full-scale development phase (Phase II).

The historical tracing of the estimate of F/A-18 development cost is presented in Figure 23.

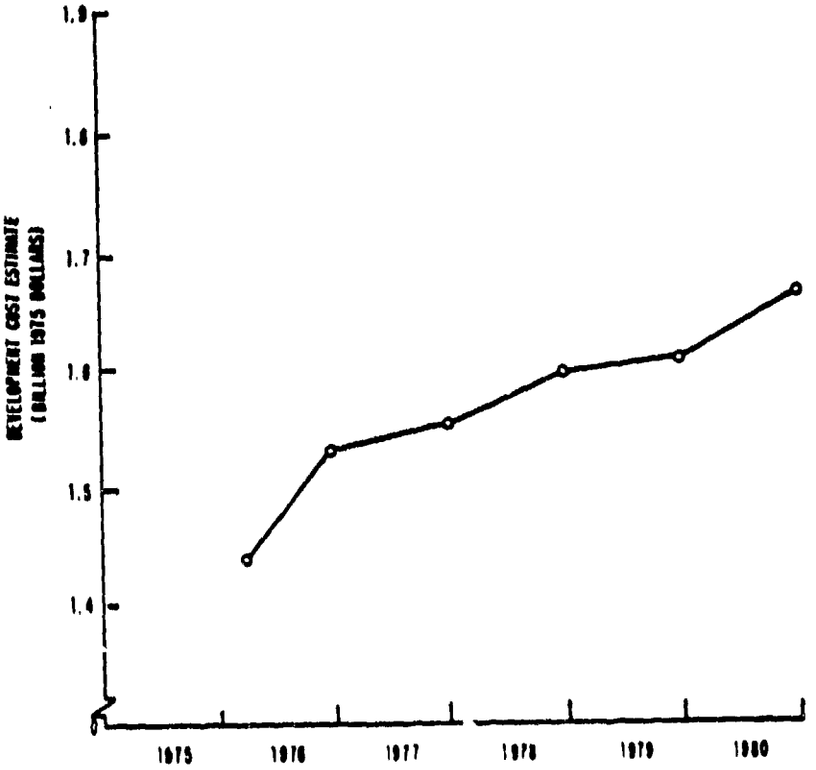

Figure 23. F/A-18 Development Cost Estimates

In the estimate of program cost produced at the time the Secretary of Defense approved full-scale development (DSARC Milestone II), it was estimated that the F/A-18 could be developed for 1.4 billion 1975 dollars. By 1980 this

estimate of cost for development had risen 15.6 percent to 1.6 billion 1975 dollars. Unlike the estimate of procurement cost, most of which will be outlaid well into the future, the F/A-18 development is presently well on its way to completion. Therefore, the current estimate of development cost should be relatively accurately known. (The development cost is independent of the F/A-18 inventory objectives.)

2. Procurement Cost

The procurement cost may be further broken down into flyaway cost, support cost and initial spares.

Flyaway cost is a generic term related to the creation of a usable end item. For the F/A-18 the flyaway cost includes the airframe, engine, accessories, electronics, communication equipment, armament, government furnished equipment and the cost of changes made to the above.

Support cost includes installation support, depot maintenance; supply management, second destination transportation, personnel support and training.

The initial spares category includes those initial spare components, assemblies, and initial repair parts used for replacement purposes in the flyaway airplane until the regular supply pipelines are operative.

The historical tracing for the estimate of all F/A-18 procurement cost is shown in Figure 24.

The development estimate of all procurement cost was 6.5 billion 1975 dollars and the December 1980 current

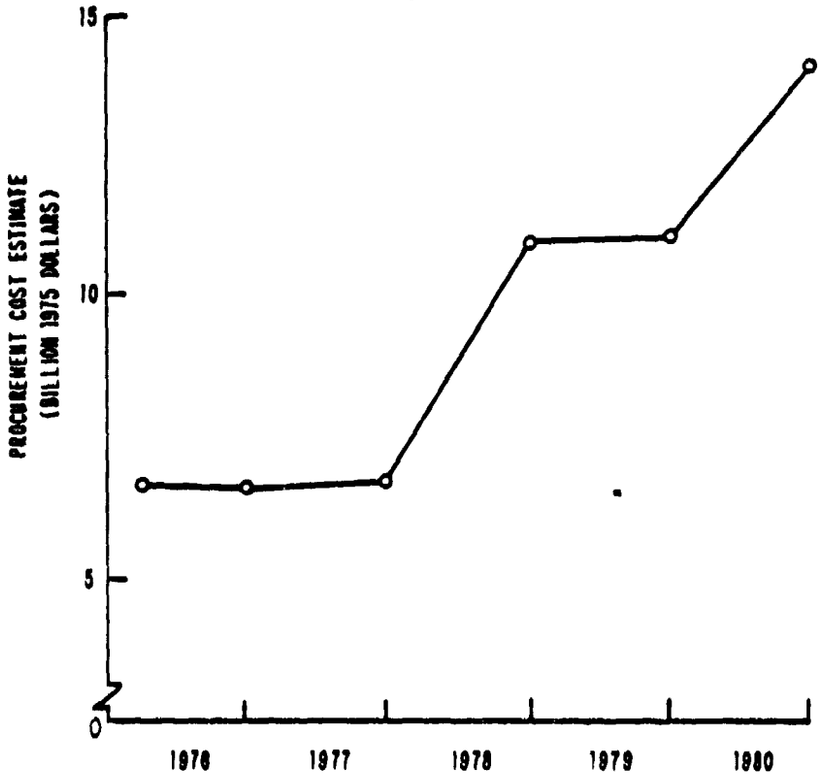

Figure 24. F/A-18 Procurement Cost Estimates

estimate was 14.1 billion 1975 dollars. The large increase in 1978 procurement cost is largely caused by the increased cost associated with the decision to buy 1366 airplanes instead of 800 airplanes.

3. Military Construction Cost

The military construction cost includes the construction of training facilities peculiar to the weapon system being acquired. The military construction cost for the F/A-18 program represents a relatively small proportion of total program cost and provides for facilities for Navy and Marine air crew and maintenance personnel training. The Navy

facilities are planned for Naval Air Stations Lemoore, California, and Cecil Field, Florida. The Marine facilities are to be constructed at Marine Corps Air Stations El Toro, California, and Yuma, Arizona.

The development estimate of F/A-18 military construction cost was 18 million 1975 dollars, and the December 1980 current estimate was 30.8 million 1975 dollars. The historical tracing of program military construction cost estimate is provided in Figure 25.

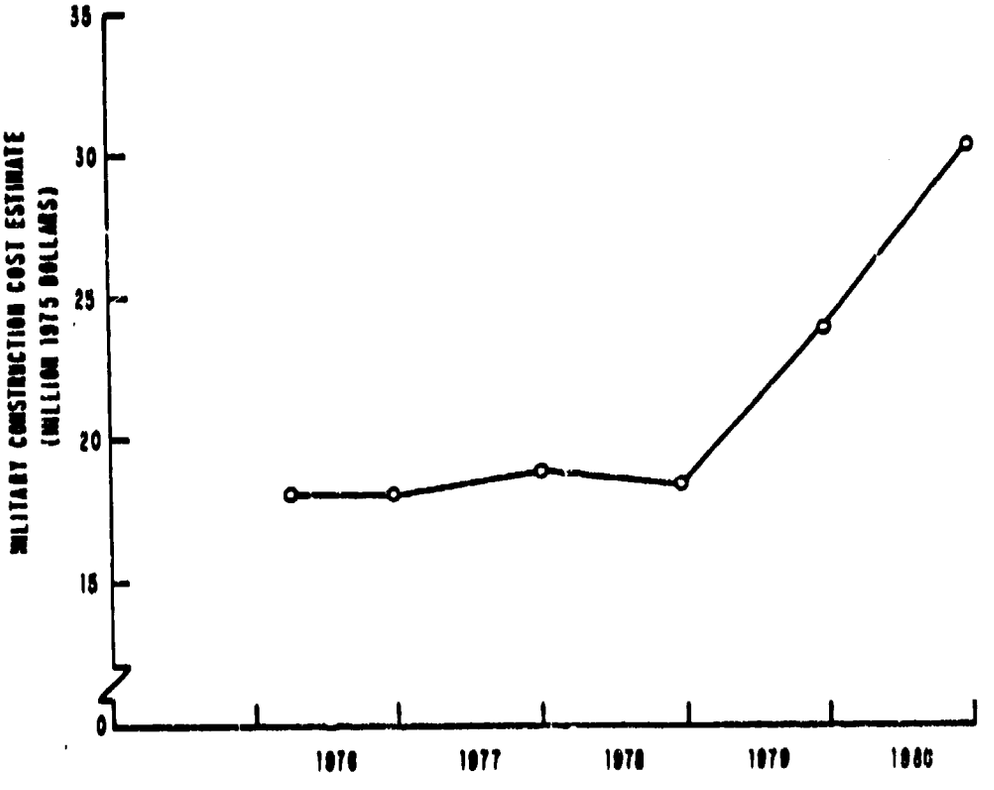

Figure 25. F/A-18 Military Construction Cost Estimates

According to the Selected Acquisition Reports, the increased estimate of military construction cost in 1979 and 1980 reflects, "a revision of earlier estimates based on new engineering studies and a revised base loading plan." No further amplification was provided in the Selected Acquisition Reports, but a program office official stated that, "You can translate that to say that they (government civil engineers) found they could not get the facilities constructed for the amount estimated back in 1975."

4. Percentage Analysis (Breakdown) of Total Program Cost Estimates

Figure 26 shows the total program cost estimates broken down into development, procurement (flyaway, support, initial spares), and military construction costs.

By far, the procurement cost constitutes the largest proportion of total program cost. Over 80 percent for the planned 800 airplane buy to just under 90 percent for the planned 1366 airplane inventory objective is due to procurement cost. Development costs, which were recognized earlier to be independent of the inventory objective, represent a smaller percentage of total program cost as the buy increases.

A compression of support cost percentages is identifiable in Figure 26. Interviewees at the Naval Air Systems Command related that this compression has two probable causes: 1) Increased economies of scale and 2) "perhaps", some short-changing of program support in an attempt to "manage" total

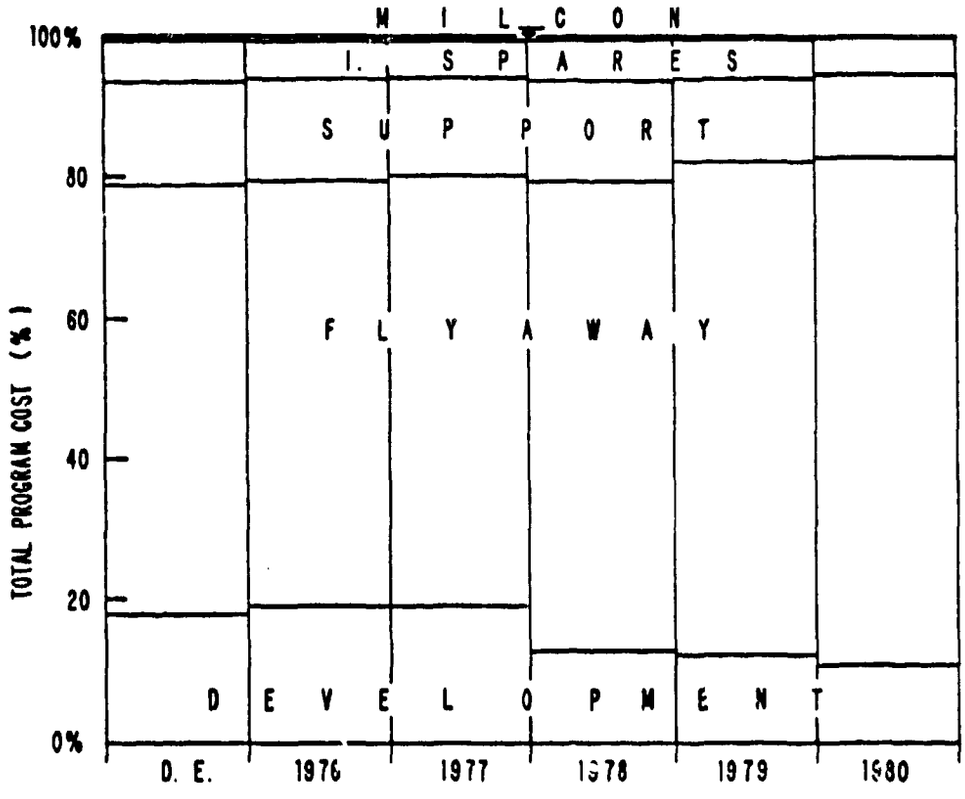

Figure 26. F/A-18 Total Program Cost Estimates--Percentage Analysis

program cost growth. The analysis of cost variance which follows will provide additional insight into support cost.

C. COST VARIANCE ANALYSIS

1. General

There is always a need to maintain an accounting control system that emphasizes the differences between actual cost or updated estimates of actual cost, and the original estimate of cost. In the Selected Acquisition Reports this is accomplished via cost variance categories. Cost variance is defined as the difference between the baseline (development estimate) and the current estimate for the following categories:

- Economic
- Quantity
- Schedule
- Engineering
- Estimating
- Support

The following is a discussion of these categories in more detail.

2. Economic Variance

The Selected Acquisition Report guidance defines economic variance as the category which reflects changes that are due solely to the operation of the economy. Perhaps a better definition would include the comment that this category reflects the Office of the Secretary of Defense view of the economy. This is true because, by definition, an economic change is recognized only when the escalation indices provided by the Office of the Secretary of Defense differ from those previously provided regarding future escalation.

a. Generic Example of Economic Variance

An example may make this clearer. Assume a program manager planned to outlay the equivalent of 100,000 base year dollars each year for five years, and that the price level indexes were assumed to be as depicted in Table 6.

TABLE

HYPOTHETICAL OSD PRICE [illegible] (PLI)

YEAR	OSD PRICE [illegible] DEX
Base	1.00
2nd	1.03
3rd	1.10
4th	1.16
5th	1.19

Then the original estimate of program cost would be estimated as:

$100,000	x 1.00	=	$100,000
100,000	x 1.03	=	103,000
100,000	x 1.10	=	110,000
100,000	x 1.16	=	116,000
100,000	x 1.19	=	119,000
$500,000			$548,000
Base year			Then year

Now, assume at the end of the year two, the Office of the Secretary of Defense changes the estimate of inflation and issues the new index numbers, for years three, four and five, depicted in Table 7.

TABLE 7

ORIGINAL & UPDATED, HYPOTHETICAL OSD PRICE LEVEL INDEX (PLI)

Year	OSD Price Level Index (PLI)	
	Original	Updated
Base	1.00	1.00
2nd	1.03	1.03
3rd	1.10	1.18
4th	1.16	1.25
5th	1.19	1.31

Now, the current estimate of program cost would be:

$100,000	x 1.00	=	$100,000
100,000	x 1.03	=	103,000
100,000	x 1.18	=	118,000
100,000	x 1.25	=	125,000
100,000	x 1.31	=	131,000
$500,000			$577,000
Base year			Then year

The difference between the original then year program cost estimate ($548,000) and the current estimate of the then year program cost ($577,000) would be assigned to economic variance ($577,000 - $548,000 = $29,000).

Note that no adjustment was made for possible errors in previous years indexes. Even if it were known from

actual experience that the index for year two, the year just past, should have been 1.11, it is not recognized in the calculation of economic variance.[7] The result of this failure to recognize actual inflation may be seen below:

$$\$_{\text{Base Year}} = \frac{\$_t}{PLI_t}$$

$$\$_{\text{Base Year}} = \frac{\$_{\text{2nd Year}}\ 103{,}000}{1.11} = 92{,}800.$$

Since year two outlays were held to 103,000 then year dollars; in effect, the program did not outlay the equivalent of 100,000 base year dollars but outlaid only the equivalent of 92,800 base year dollars during year two. Consequently, less real asset value was purchased in year two than was planned.

b. F/A-18 Economic Variance

Not unlike the above example, the F/A-18 program cost variance has been reported in the Selected Acquisition Reports without recognition of, or correction for, actual inflation experienced in the years prior to each report. The F/A-18 program economic variance does reflect continued annual

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[7] DOD INSTRUCTION 7000.36 makes provisions for corrections to Selected Acquisition Report data for "actual escalation in prior years," provided approval is granted by the Assistant Secretary of Defense, Comptroller. However, this researcher found that most Naval Air Systems Command program offices in general and F/A-18 Program Office in particular, were unfamiliar with this provision. The Office of Secretary of Defense stated that the Navy had not requested such approval as of December 1980.

upward adjustment in the Office of the Secretary of Defense estimate of future inflation. As may be seen in Figure 27, the F/A-18 program suffered a positive economic variance (an increase in cost) every year since the formulation of the development estimate. Since the vast majority of F/A-18 outlays lie in the future (out to 1989), and because of the compounding effect of inflation, increases in estimates of the future inflation produce dramatic increases in program economic variance.

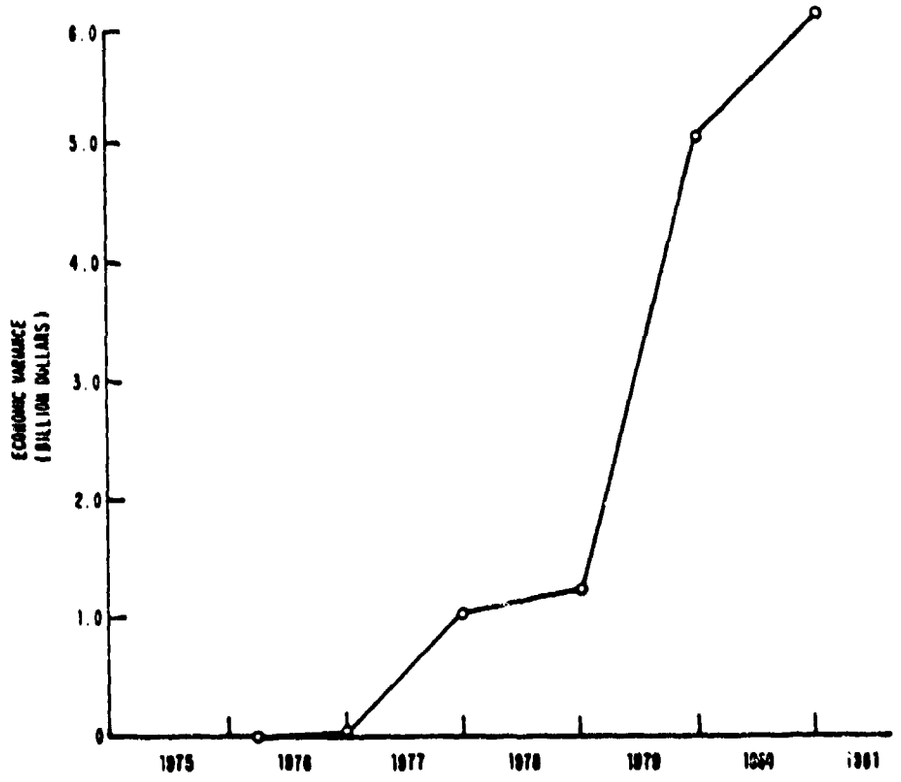

Figure 27. F/A-18 Economic Variance

Particularly, note the $3816.1 million dollar increase in economic variance reported for 1979. The economic conditions prevailing during 1979 caused the Office of the Secretary of Defense to markedly increase the estimate of inflationary impact during the eighties.

3. Quantity Variance

Quantity variance is defined as a change in the estimated quantity of airplanes to be produced. The cost of the quantity change is based on the original cost-quantity curve derived for the development estimate. The F/A-18 development estimate cost-quality curve is presented in Figure 28.

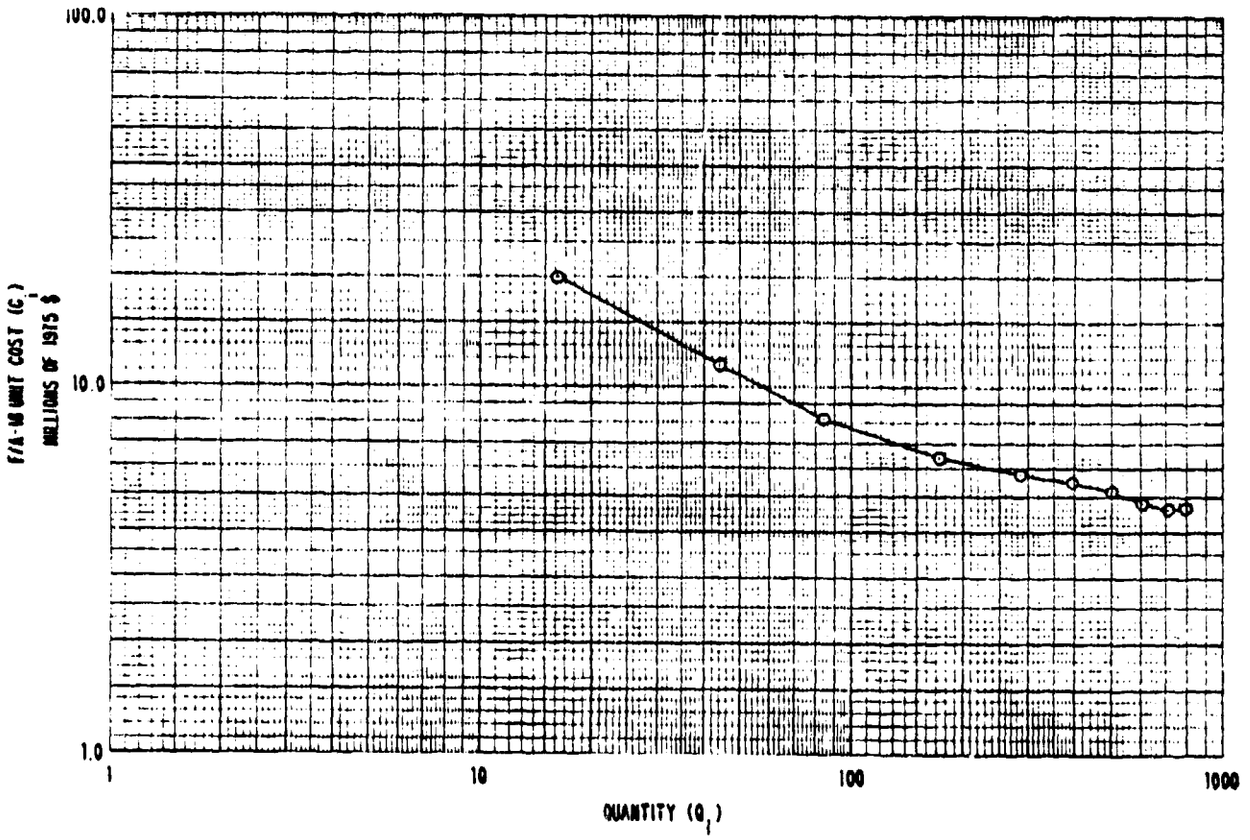

Figure 28. F/A-18 Development Estimate Cost Quantity Curve (Unit, Flyaway)

These data represented in Figure 28 do not plot as a straight line (on log-log paper) as did the theoretical learning curve discussed in Chapter two.[8] However, this curve does depict the decreasing unit cost associated with subsequent units of production.

The Navy was able to take advantage of this cost savings when the decision was made in 1978 to increase the F/A-18 inventory objective from 800 airplanes to 1366 airplanes. This decision was made because the original inventory objective (800 airplanes) was inadequate to fulfill fleet requirements. This was discussed in a 1978 Naval Audit Report that stated that the original 800 airplane inventory objective comprised only the aircraft needed to equip planned Navy and Marine Corps fighter and attack squadrons, and that it did not include aircraft that will be needed to replace losses through attrition; neither did it address the Navy reserve and reconnaissance aircraft requirements or the Marine light attack requirements that may have to be met by the F/A-18.[9] [41: a-1]

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[8]This is true because, among other things, contractor overhead and other fixed costs are included in the flyaway cost.

[9]The inventory objectives shown in the DSARC Decision Coordinating Paper No. 141 calls for achieving fleet force levels in 1989 and maintaining those levels for 10 years. As discussed in the December 1978 Selected Acquisition Report, the 800 airplane inventory objective did not include the estimated 146 additional airplanes required to sustain the desired force after 1989. Additionally, the 800 airplane plan

The estimated 3.079 billion 1975 dollars required to acquire these 566 airplanes is shown in the historical tracing of F/A-18 quantity variance presented in Figure 29.

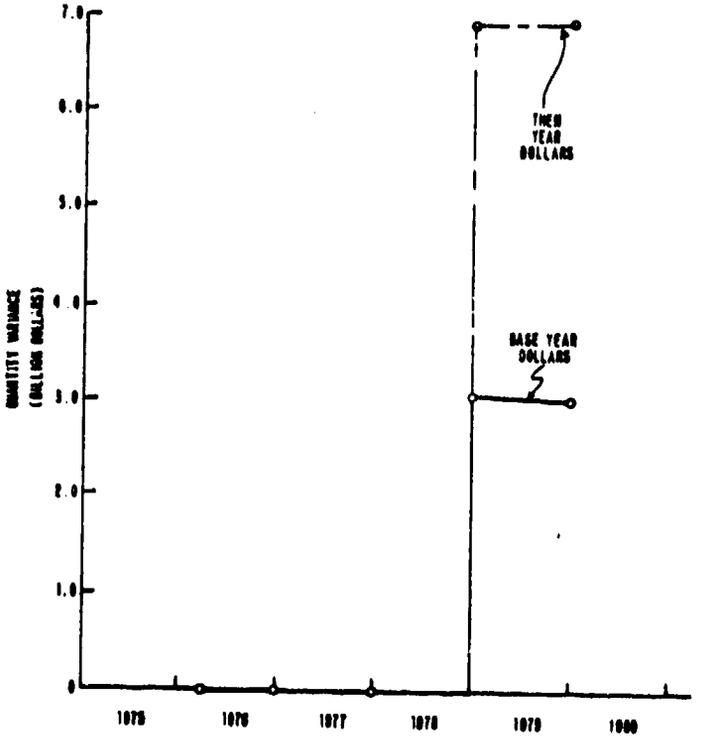

Figure 29. F/A-18 Quantity Variance

These 566 airplanes will be less expensive because they are to be produced "further down" the learning curve. However, this increased buy greatly increases the estimate of total program cost.

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did not include the estimated 98 airplanes that may be required to fulfill a tactical reconnaissance role, nor the 322 airplanes that will be required to fulfill the USMC light attack mission. (800 + 146 + 98 + 322 = 1366).

4. Schedule Variance

Schedule variance reflects changes in procurement or delivery schedules, completion date or intermediate milestones for development or production.

The schedule variance history for the F/A-18 program is depicted in Figure 30.

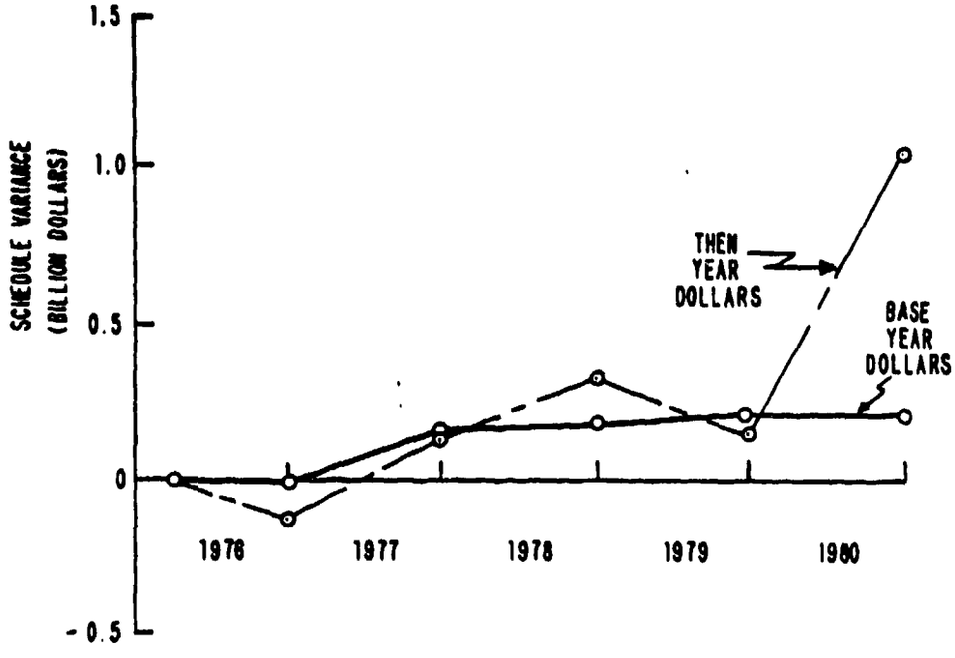

Figure 30. F/A-18 Schedule Variance

In terms of base year dollars, production start-up delays (for example, those due to delays in flight test completion) or slowing production rates, (due to insufficient funding) yields relatively small cost growth. This growth

results from incurring more fixed cost (overhead) during the longer production and from decreased efficiencies.

However, while the cost growth in terms of base year dollars may be relatively small, the cost growth associated with schedule variance in then year dollars can be more significant. This is because delaying the start of production or slowing production rates moves outlays further into future years and the effects of inflation are suffered over a longer period. Whereas the schedule variance as of 1980 was only 209 million base year dollars, this is equivalent to over 1 billion then year dollars.

5. Engineering Variance

Any alteration in the physical or functional characteristics of a system to be delivered or under development after establishment of such characteristics is defined as engineering variance. As was discussed in Chapter two, engineering changes are made to bring the performance of a system up to expected standards, to incorporate advances in the state of the art, and to strive for technical perfection.

One might expect engineering variance to appear largely during the prototype preparation for first flight and following the deficiency identification accomplished during the early flight test and evaluation. This seems to have been the case with the F/A-18. The first test flight was in November of 1978. The historical tracing of F/A-18 engineering variance is shown in Figure 31.

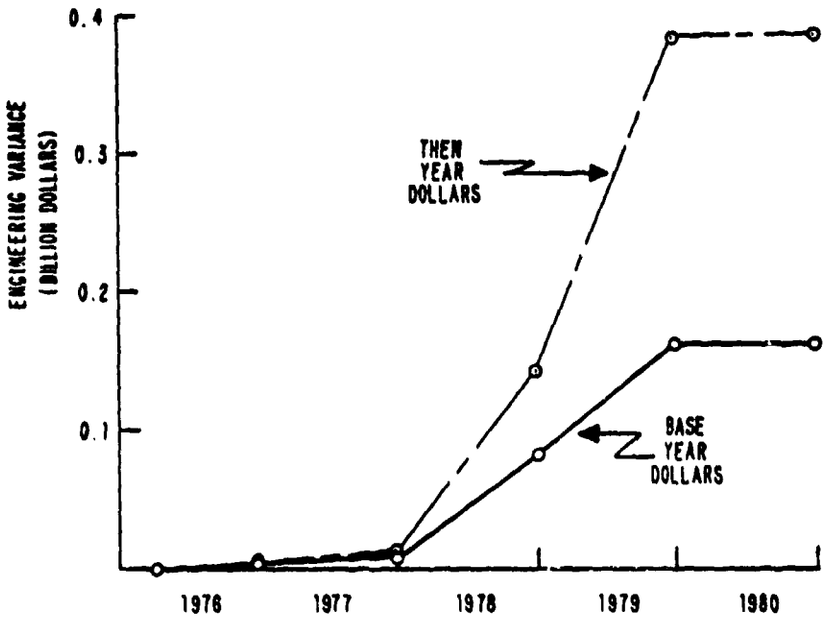

Figure 31. F/A-18 Engineering Variance

Engineering changes identified during development are built into production airplanes throughout the production years. Consequently, the cost in terms of then year dollars will be much higher than the cost in terms of base year dollars. For example, the 160 million 1975 dollar engineering variance figure shown on Figure 31 (December 1980) would be 381 million if expressed in then year dollars.

6. Estimating Variance

The Selected Acquisition Report instructions define estimating variance as: "a change in program cost due to a correction of error in preparing the development estimage."

The estimating variance history for the F/A-18 is presented in Figure 32.

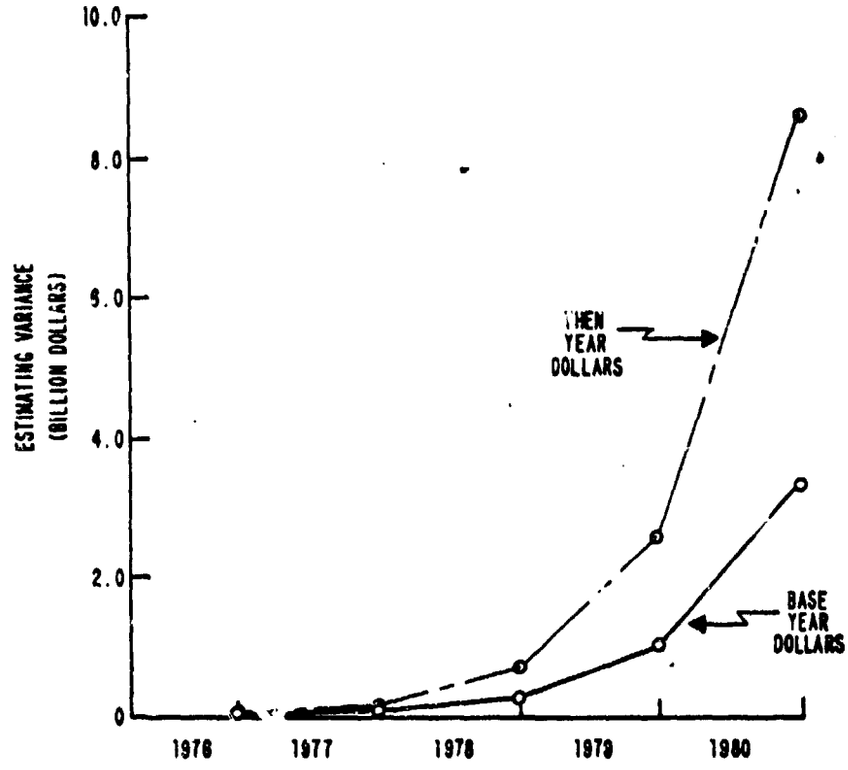

Figure 32. F/A-18 Estimating Variance

By December 1980, this estimating variance amounted to 3.4 billion 1975 dollars. However, the definition of estimating variance is misleading since "errors" in the development estimate may be real or may represent political maneuvering. Also the failure to recognize all inflation as economic variance will cause cost growth due to unrecognized inflation to appear in the Selected Acquisition Reports as estimating variance.

a. Political Impact on Development Estimates

A former Deputy Under Secretary of Defense for Research and Engineering, interviewed by this researcher, discussed the political problem of "correctly" producing a development estimate of weapon systems cost. The Deputy Under Secretary related that, "The Washington political environment forces (F/A-18 and other) program managers to produce cost estimates that are on the margin between the plausible and the implausible." This official's amplifying remarks can be summarized by defining a continuum formed by cost estimation extremes. Located on the lower cost extremity would be an estimate which is unrealistically low but politically attractive. This estimate might serve as a "foot in the door" strategy. But, as the program matures, large cost growth would become evident. At the other extreme would be an estimate that is sufficiently large to cover all program cost, with high probability, even allowing for "bad luck." The problem here is that, while the program would not suffer from cost growth, the original estimate may be so large that decision makers might well deem it more economically attractive to reject the program and seek alternative means of fulfilling the same requirement. This would be especially true if the decision makers have historically become accustomed to expecting a program to cost more than the initial estimates. "There is unfortunately more to cost estimating than looking to see what falls out the bottom of a parametric analysis," said this former official.

b. Cost Growth Due to Unrecognized Inflation

As previously intimated, cost growth resulting from low development estimates is not the only cause of estimating variance. Also included in estimating variance, but not identified or discussed in the Selected Acquisition Report instructions, is inflationary cost growth over and above that inflation recognized in the Office of the Secretary of Defense estimates of inflation. Airplane procurement contracts are written annually and contractors are paid in current dollars. If the price level index produced from the Office of the Secretary of Defense inflation assumptions is lower than actual inflationary experience, the result is that less asset value (in terms of base year dollars) is procured than indicated by calculations using the Office of the Secretary of Defense indexes. A numerical example of this was offered in the earlier section (2) on escalation variance. Faced with this dilemma, a program manager must either buy less program or suffer cost growth by providing the extra current dollars required to produce the required asset value. If the latter course of action is pursued, this cost growth will show up as estimating variance.

Consider the December 1980 F/A-18 Selected Acquisition Report which contains the following quote:

> The Office of Secretary of Defense escalation adjustments have not been in line with actual industry experience and have created budget shortfall that has to be absorbed into the base estimate. The Office of the Secretary of Defense policy has been to adjust the economic escalation factors

> for subsequent procurements for inaccurate estimates but with no allowance for recovery of prior year escalation where the rates projected were less than actual industry experience. This means that the base years estimate of the program, which is expressed in fiscal year 1975 dollars includes a certain amount of absorbed escalation.

The following analysis will quantitatively identify estimating variance which is really unrecognized inflation (absorbed escalation) from past years.

(1) Office of the Secretary of Defense Estimates of Inflation. Each Selected Acquisition Report contains the latest Office of the Secretary of Defense estimate of annual escalation rates applicable to the budget year and each subsequent year of the program being reported. These inflation estimates are provided for development cost, procurement cost, and military construction cost. The evolution of these estimates may be viewed in Appendix C. These numbers were extracted from the first F/A-18 Selected Acquisition Report (March, 1976) and from each subsequent December report.

These Office of the Secretary of Defense estimates of inflation for past years should be viewed relative to inflation measured by the broad, Gross National Product (GNP) deflator, the more familiar Consumer Price Index (CPI), and the "actual" industrial experience. These measures of inflation and the Office of the Secretary of Defense estimates of inflation are presented in Table 8 for years 1976 through 1980.[10]

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[10]To simplify the presentation, the transition quarter 1971 has been omitted. The fact that CPI and GNP data reflect

TABLE 8

COMPARISON OF INFLATION RATES

		Year: 19XX				
		76	77	78	79	80
GNP Deflator		5.2	5.8	7.3	8.5	9.0
CPI		4.8	6.8	9.0	13.3	11.7
"Actual"	Dev.	8.7	8.2	8.9	11.3	11.5
	Pro.	10.1	8.3	9.0	11.5	12.8
	Milcon.	4.0	8.6	12.4	13.6	10.7
OSD Est.	Dev.	9.0	7.0	7.0	7.0	6.3
	Pro.	9.0	9.0	7.0	6.0	6.2
	Milcon.	9.0	7.0	5.0	7.0	7.0

Generally, the inflation estimates issued by the Office of the Secretary of Defense for development, procurement and military construction cost were lower than the GNP deflator, CPI and "actual" inflation measures.[11] The "actual" data relating inflationary experience of the aerospace industry were the highest of all.

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calendar years and the OSD and "actual" data reflect fiscal years has been disregarded. The OSD estimates are the historical estimates of inflation used in the computation of the current (Dec. 1980) estimate of program cost. They are reproduced from Appendix C.

[11]Some of the Office of the Secretary of Defense inflation estimates were higher than GNP deflator and CPI in 1976 and 1977. However, relatively few F/A-18 program funds were outlaid in those years.

These "actual" measures were constructed by the Naval Air Systems Command in conjunction with the Naval Material Command, using the Data Resources, Inc. Econometric Data Base. All high level and working level government procurement personnel interviewed conscientiously expressed the belief that these "actual" data represented the best available measures of F/A-18 program inflationary experience. For the analysis that follows the assumption is made that their expert opinion is correct.

(2) Recognition of Unrecognized Inflation. Having assumed that the "actual" inflation data are correct, the intent now is to adjust the estimates of F/A-18 program cost reported in the December 1980 Selected Acquisition Report for the difference between the Office of the Secretary of Defense-issued estimates of inflation and these "actual" measurements of inflation.

This is accomplished by identifying the string of then year outlays (historical and current estimate of future cash flows) for the F/A-18 program.[12]

Then, these cash flows are deflated using a price level index made up of the "actual" inflationary data for past years and the December 1980 Office of the Secretary

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[12]These cash flows are not published in the SAR's but are the basis for SAR cost estimates. They were provided by for the program office and are presented in Appendix D.

of Defense, estimates of future escalation. The worksheets and a detailed, step-by-step description of methodology for these calculations is presented in Appendix D. The results are presented in Table 9.

TABLE 9

F/A-18 PROGRAM
UNRECOGNIZED INFLATION
(M $)

	Current Estimate Dec. 1980 SAR (1975 $)	Current Estimate Dec. 1980 SAR Adjusted for "Actual" Inflation (1975 $)	Cost Growth Due to Unrecognized Inflation (1975 $)
Development	1,661.6	1,524.0	137.6
Procurement	14,065.6	12,403.2	1,662.4
Military Construction	30.8	27.8	3.0
Total Program Cost	15,758.0	13,955.0	1,803.0

The cost growth due unrecognized inflation, figure represents the difference between the December 1980 Selected Acquisition Report, current estimate, (1975 dollars) and this same estimate recalculated using the "actual" measures of inflation for past years.

This analysis indicates that the estimate of total program cost reported in the December 1980 Selected Acquisition Report is 11 percent or 1.8 billion 1975 dollars

in excess of the actual base year cost. Likewise, the economic variance reported understates the "actual" impact of economic change on the program by 1.8 billion 1975 dollars, and the estimating variance (the catch-all category) is overstated by 1.8 billion 1975 dollars.

7. Support Variance

Any change in cost associated with elements not included in flyaway cost is reported as support variance. Herein included are cost changes (relative to the development estimate) associated with training and training equipment, peculiar support equipment, operational or site activation, initial spares and repair parts, and changes in construction requirements. The support variance history of the F/A-18 program is depicted in Figure 33.

Note that the support variance is the only category which has ever decreased in magnitude after having gone positive (1979). Naval Air Systems Command and the Office of the Secretary of Defense interviewees indicated (in general, not specifically addressing the F/A-18) that this may be because support cost possesses some "pseudo-management reserve character." In other words, they suggested that the program manager has some ability to buy less support than that actually required. This would allow support variance and hence total program cost to be reported as lower than that required to fulfill the spirit of the development estimate.[13]

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[13]The F-14 and the S-3 were Navy programs mentioned as having been "cut short" in terms of support; no quantitative data was presented.

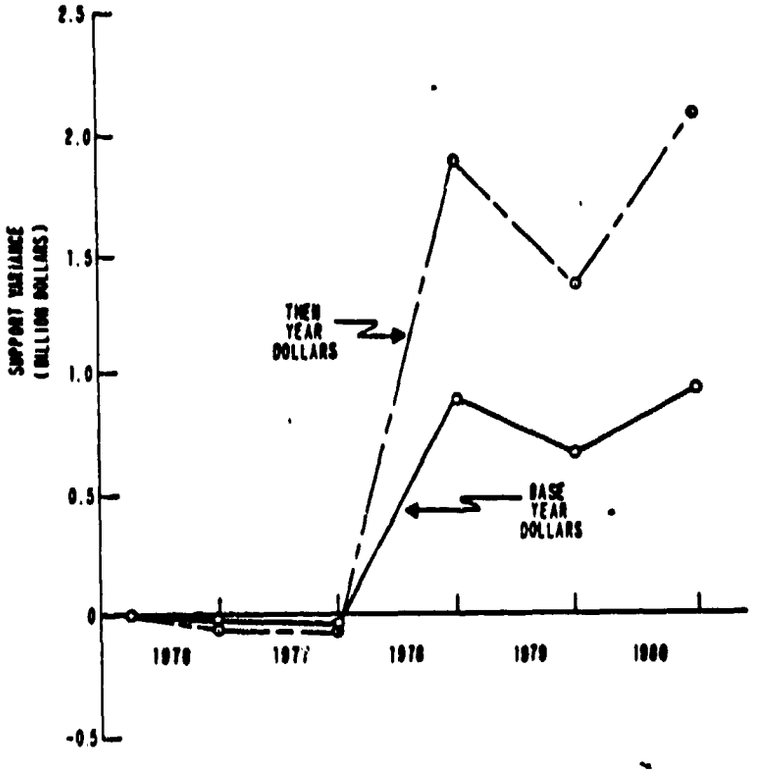

Figure 53. F/A-18 Support Variance

Also, the support category provides some flexibility in leveling the rate of cost growth. Interviewees pointed out that the estimated amount of support cost can be artificially reported as lowered during a period of high cost growth and corrected later.

8. Variance Computation

Before comparing the relative magnitude of the variance categories, two details need to be addressed. The first has to do with the order of variance computation and the other concerns the escalation associated with program change.

a. Order of Computation

The order in which variance categories are calculated can determine the magnitude of change assigned to a particular category. Consider a hypothetical program in which 20 units are to be procured at $10 each. The total cost will be:

$$20 \text{ units} \times \frac{\$10}{\text{unit}} = \$200.$$

If the unit cost increases from $10 to $15 for reasons not assigned to other categories, the increase would be attributed to estimating variance. If, because of this increased cost, the decision was made to acquire five fewer units, this would be a change in quantity variance.

If the estimating variance is computed first the amount would be:

$$\text{Estimating variance} = (20 \text{ units} \times \frac{\$15}{\text{unit}}) - (20 \text{ units} \times \frac{\$10}{\text{unit}}) = \$ +100.$$

And, then the quantity variance would be:

$$\text{Quantity Variance} = \$15 \text{ units} \times \frac{\$15}{\text{units}}) - (20 \text{ units} \times \frac{\$15}{\text{units}}) = \$ - \$75$$

The net program cost change would be ($ + 100) + ($ -75) = $ +25.

However, if the quantity variance is computed before the estimating variance the amount would be:

$$\text{Quantity Variance} = (15 \text{ units} \times \frac{\$10}{\text{unit}}) - (20 \text{ units} \times \frac{\$10}{\text{unit}}) = \$ -50$$

And, then the estimating variance amount is calculated:

$$\text{Estimating Variance} = (\$15 \text{ units} \times \frac{\$15}{\text{unit}}) - (15 \text{ units} \times \frac{\$10}{\text{unit}}) = \$ +75.$$

Here also the net program cost change would be $ +25, but the amounts assigned to estimating and quantity variance differ.

Recognizing the requirement for consistency, DOD Instruction 7000.3 mandates the following computational order:

> Economic Variances are computed first since they are due solely to operation of the economy.
>
> Quantity Variances are calculated next because current period engineering and estimating changes may change the cost-quantity curve assumptions.
>
> Schedule Variances are next because this completes the defined scope of the current program.
>
> Engineering, and Estimating Variances are computed next (in that order) purely in the name of consistency.
>
> Support Variances are computed last because some support items are estimated as a function of flyaway cost.

b. Program Change-Related Escalation

Program change escalation is the difference between the then year and the base year dollar cost estimates for each change contributing to a variance category at the time a change is made.[14] Once a program change-related escalation

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[14]The program change-related escalation for the F/A-18 program may be viewed by looking back at the historical tracing for quantity (Figure 28), schedule (Figure 30), estimating (Figure 32) and support (Figure 33) variances. The vertical distance between the base year dollar curve and the then year dollar curve at each data point represents the program change-related escalation as it was reported in the December Selected Acquisition Reports. From the viewpoint of

estimate is added to the base year estimated cost of a change, future changes resulting from revision of indices will be reflected in the economic change category, even though such changes may impact upon a previously calculated program change-related escalation.

Consider an example: Assume a deficiency is identified during flight test that requires an engineering change. Further assume that the cost of the engineering change adds 1,000 base year dollars to the cost of each airplane. The contribution to the engineering variance, in terms of base year dollars, would be $1,000 times the number of airplanes to be produced. The contribution to the engineering variance, in terms of then year dollars, requires that the series of 1000 base year dollar, cash flows be inflated by the Office of the Secretary of Defense escalation index in existence when the change is made. The next year, if the Office of the Secretary of Defense escalation index changes, the adjustment to the then year dollar cost of this engineering change would affect only the economic variance category. This is done to simplify the Selected Acquisition Report computational requirements.

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controlling cost, program change-related escalation is very important. While it is unrealistic to expect to manage a major weapon system acquisition without making changes, program managers must realize that the cost of those changes will be magnified by inflation.

D. MAGNITUDE OF F/A-18 COST GROWTH CONSIDERING "ACTUAL" INFLATION

Earlier in this chapter it was related that the F/A-18 cost growth was 32 percent in terms of base year dollars adjusted for the quantity increase. However, the base year dollar figure which was adjusted was that published in the December 1980 Selected Acquisition Report. As was noted in the previous section on estimating variance, the base year dollar, estimate reported in the Selected Acquisition Reports contains cost growth due to unrecognized inflation. The analyses of the magnitude of F/A-18 cost growth may now be refined so as to adjust this base year dollar estimate for both the quantity variance and for the 1.8 billion 1975 dollar cost growth due to unrecognized inflation. The result is that the F/A-18 program cost growth, as of December 1980, was only 10.0 percent when both the quantity change and "actual" inflationary experience are considered.

E. COST GROWTH--PROGRAM MANAGER CONTROL

In the previous sections cost variance categories were examined in some detail. This has laid the groundwork for examining the relative contribution of individual variance categories to total program cost growth. This relative comparison will then support identification of cost growth factors which can and cannot be controlled by program managers.

The December 1980 Selected Acquisition Report presents the latest cost variance data produced in concert with a

Presidential budget. The relative magnitude of these F/A-18 cost variance categories are presented in Figure 34.

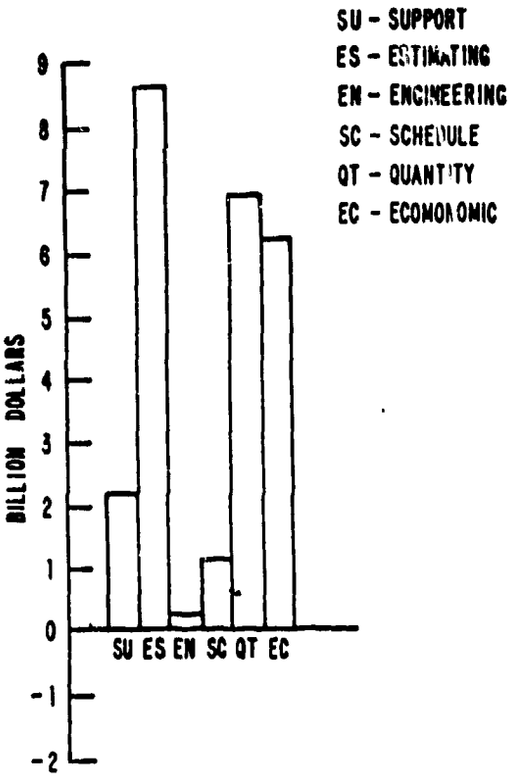

Figure 34. Relative Magnitude of F/A-18 Cost Variance Categories

1. Economic Variance

Economic variance as reported in the December 1980 Selected Acquisition Report, constituted 24.2 percent of total F/A-18 cost growth. This represents the increased program cost associated solely with the operation of the economy as estimated by inflation indices issued by the Office of the Secretary of Defense. Practically speaking, the program

manager had no control over the operation of the economy, and therefore had no control over this cost growth category.

2. Quantity Variance

Quantity variance made up 27.5 percent of total program cost growth and represented the cost associated with increasing the F/A-18 inventory objective from 800 airplanes to 1366 airplanes.[15] Inventory objective decisions were made by requirements analysis and managers within the Office of the Chief of Naval Operations. The Naval Air Systems Command Program Manager had no control over the inventory objectives.

3. Schedule Variance

Schedule variance represented 4.2 percent of total F/A-18 program cost growth. This variance resulted from changes to the procurement schedule envisioned in the Development Estimate. Slow progress of the F/A-18 test and evaluation forced a change in the planned production build-up rate, and the program manager is responsible for control over the progress of development testing.

However, a former Systems Commander pointed out that more generally, schedule variance was a product of the PPBS process. As the Navy and the nation attempt to share scarce dollar resources among competing requirements, a program may fair better some years than others. If the Congress appropriates fewer funds than are requested in the Navy's Program

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[15] As measured on the development estimate cost quantity curve.

Objectives Memorandum and requirements have not changed, then the option is to stretch out the delivery schedule. The program manager cannot be held responsible for schedule variance which was a product of the PPBS process.

4. Engineering Variance

Engineering variance accounted for 1.5 percent of total program cost growth. Since this category represents the cost of changes in the physical or functional characteristic of a system, a program manager would be expected to have exercised control over these engineering changes.

5. Estimating Variance

Estimating variance constituted the largest category at 34.2 percent of total program cost growth. This category, by definition, reflects changes in program cost due to correction of errors in preparing the development estimate. However, as discussed previously, if the inflation estimated by the Office of the Secretary of Defense is less than that actually experienced during previous years, estimating variance will also reflect increased cost due to unrecognized inflation. This research effort found that 1.803 billion 1975 dollars of cost growth was reported as estimating variance because of cost growth due to unrecognized inflation. This represented 53.5 percent of the reported estimating variance and (53.5 x 34.2 =) 18.3 percent of total program cost growth.

Just as with economic variance, the program manager had no control over cost growth due to unrecognized inflation.[16]

The remaining 46.5 percent of the reported estimating variance represented (46.5 x 34.2 =) 15.9 percent of total program cost growth. This indicates that the development estimate was lower than experience to date indicates it should have been. This cost growth, due to overly optimistic cost estimating, was controllable, but controllable only by the program manager in command when the development estimate was prepared. Political constraints may have rendered it largely uncontrollable, in effect; and subsequent program managers were left to suffer the consequences.

6. Support Variance

Support variance composed 8.4 percent of total F/A-18 program cost growth. Support variance reflects changes in program cost not associated with flyaway cost. However, support items are generally a function of flyaway cost. Thus, if quantity variance is positive, one would expect to see a positive support variance. As was previously discussed, the

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[16]The approximation is made here that

$$\frac{\text{\$75 (cost due to unrecognized inflation)}}{\text{\$75 total cost growth}} = \frac{\text{\$ Then Year (cost due to unrecognized inflation)}}{\text{\$ then total cost growth}}.$$

While not precisely correct, the error is believed to be small and correction would not justify detailed computations requiring identification of individual cash flows associated with this category.

recognition of support cost may allow for some leveling of cost growth rate, and some needed support may not be recognized. Generally, program managers can exercise some control over support variance and can covertly suppress cost growth by denying or delaying recognition of needed support.

7. Degree of Program Manager Control

Table 10 summarizes opportunities for the program manager's control of program cost growth.

TABLE 10

PROGRAM MANAGER CONTROL OF F/A-18 COST GROWTH

Variance Category	Percent of Total F/A-18 Program Cost Growth	Opportunity for Program Manager Control
Economic	24.2	No
Quantity	27.5	No
Schedule	4.2	Some
Engineering	1.5	Yes
Estimating	34.2 (=15.9+18.3)	½Yes[1]; ½ No[2]
Support	8.4	Some[3]
Total:	100.0	

Notes:

1. Only the program manager commanding at the time the development estimate was prepared could control true estimating variance (15.9 percent).
2. Cost growth due to unrecognized inflation appears here, (18.3 percent).
3. Program manager can hold down this category by failing to recognize needed support. This recognition is not intended to justify this action.

This analysis indicates that the program manager had no possible control of 70.0 percent of F/A-18 program cost growth. Only the program manager in power at the time the development estimate was prepared had any control over the correctness of the baseline estimate. If this first program manager is excluded, program managers were unable to exercise control over 85.9 percent of F/A-18 program cost growth. The only cost growth category for which the program manager could be considered fully responsible is engineering variance and this constitutes only 1.5 percent of total F/A-18 cost growth. The program manager may have been expected to have had some control over schedule variance (4.2 percent) and support variance (8.4 percent).

F. POSSIBLE FUTURE COST GROWTH

This researcher does not foresee a significant likelihood of significant cost growth associated with engineering changes or schedule changes. A future decrease in the inventory objective could yield a cost reduction with respect to total program cost, but this would increase the average cost of units that are purchased. Additional support requirements may produce some cost growth. The main categories of possible future cost growth are believed to be economic change and estimating change. Not surprisingly, these are the two categories that have experienced the largest variance since the development estimate was established.

All these categories will be addressed below in greater detail. The order of presentation is the same as is used throughout this chapter.

1. Future Economic Change

There is always some possibility that the future will bring a time of stable or decreasing prices. However, historically the F/A-18 program has developed during periods of increasing prices and the general expectation is that these conditions will continue. The Office of the Secretary of Defense estimates of upcoming inflation have been consistently lower than actual F/A-18 experience and the errors have been greater the further they extended into the future. As an example, consider the evolution of inflation estimates for 1980 procurement, from the time of the development estimate through 1978.[17] These data are presented in Table 11.

TABLE 11
EVOLUTION OF THE OSD ESTIMATE OF INFLATION (PROCUREMENT) FOR FISCAL YEAR 1980

Date of Estimate	Estimate of FY 1980 Inflation (%)
Mar. 76	4.0
Dec. 76	4.5
Dec. 77	5.8
Dec. 78	6.2

[17] Recall from Chapter two that the Fiscal Year 1980 Budget was being prepared during Calendar Year 1978.

The estimate of inflation for 1980 increased every year but only to a maximum of 6.2 percent. The Naval Air Systems Command estimated that the "actual" inflation rate for F/A-18 procurement was 12.8 percent in 1980.

Estimating future inflation rates is a difficult task. However, there are econometric models (Warton and Data Resources Incorporated, to name two) which have predicted inflation more accurately than the estimates issued by the Office of the Secretary of Defense.

Officials working in the Office of the Assistant Secretary of Defense (Comptroller) offered insight into the reason why their inflation estimates are often unrealistically low. One very senior official stated, "While the directives and instructions refer to the escalation indexes as OSD rates, they really come from the Office of Management and Budget (OMB) and are in support of the President's economic program. OMB believes estimates of inflation may be self-fulfilling and to 'realistically' budget for inflation would seem to provide governmental sanctions (for) a stated rate of inflation."

Given this understanding coupled with the observed historical relationship between the Office of the Secretary of Defense estimates of inflation and actual experience, it does not seem unreasonable to suggest that the economic variance is presently understated and that it will grow as time

progresses.[18] Therefore, economic change is expected to substantially contribute to future cost growth.

A number of alternative methods of budgeting for inflation are currently being discussed within the Office of the Secretary of Defense. These alternative methods include: a) development of a separate deflator (index); 2) budgeting at OMB projected rates and seeking supplemental appropriations; and, 3) constant dollar budgeting and incremental funding. An Assistant Secretary of Defense (Comptroller) Staff White Paper discussing the pros and cons of these alternatives is presented in Appendix E.

2. Future Quantity Change

The F/A-18 inventory objectives are dictated by military requirements. The requirement for the F/A-18 to fulfill the role as replacement for F-4 and A-7 airplanes is pressing, and in the words of one former systems command admiral, nterviewed by this researcher, "...irreplaceable unless we are willing to accept 20-year old technology." (He was referring to buying more A-7's in lieu of F/A-18's).

However, only the future will show the total number of F/A-18 to be actually produced. Every year the U. S. budget is constrained by estimated dollar resources regardless of the total obligation authority already approved for years

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[18]The current estimate of total program cost incorporates OSD escalation estimates out to 1989.

in the Five Year Defense Plan. This being the case, each year a service budget may be reduced by the Department of Defense, the Office Management and Budget, or by the President himself before the budget is submitted to the Congress.

This being the case, it is in order to quantitatively analyze the impact that reducing inventory objectives would have on program cost.

Reducing the inventory objective would reduce total program cost. However, the total reduction would be less than the average unit cost times the number of units reduced. This is because of the learning curve effect and is apparent when studying the estimated flyaway unit cost data depicted in Figure 35.

The solid line on Figure 35 shows the history of flyaway unit cost estimates as they appeared in the Selected Acquisition Reports. When the decision was made in 1978 to increase the inventory objective from 800 airplanes to 1366, the estimated flyaway unit cost dropped because these later airplanes can be produced with more efficiency.

The dashed line shows the flyaway unit cost data adjusted back to an 800 airplane basis.[19] To have decided during 1980 to reduce the inventory objective from 1366 airplanes to 800 airplanes would have been to have suffered an

[19]These data were adjusted by removing the quantity variance and the support variance associate with production airplanes 801 through 1366, and by proportionally (566 ÷ 1366=0.41) reducing the cost growth attributed to all other variance categories.

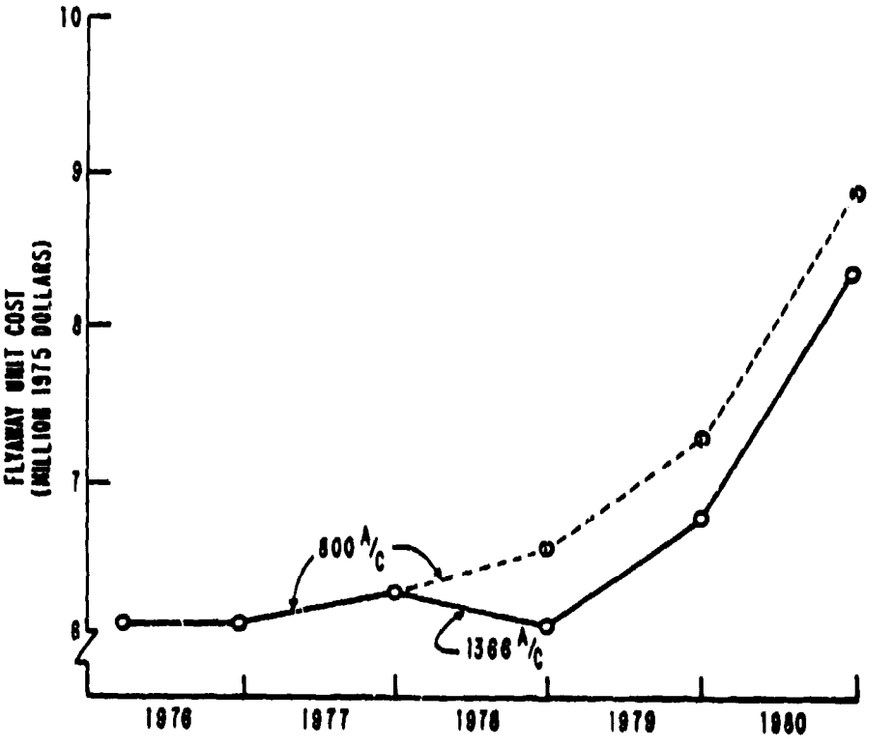

Figure 35. Estimated Flyaway Unit Cost

approximately 0.5 million 1975 dollar cost growth (per unit basis). The reduction in estimated total flyaway cost would be:

1366 Flyaway Airplanes x $\frac{8.5 \text{ million 1975 \$}}{\text{Flyaway Airplane}}$ = 11.5 billion 1975 \$

800 Flyaway Airplanes x $\frac{8.9 \text{ million 1975 \$}}{\text{Flyaway Airplane}}$ = 7.1 billion 1975 \$

Cost reduction due to decreased inventory objective: 4.4 billion 1975 \$

In this example the inventory objective was reduced 41.4 percent but the reduction to estimated total flyaway cost was only 38.2 percent. The average flyaway unit cost increased almost five percent.

3. Future Schedule Change

There is always another option to reducing the inventory objective in face of budget constraints. That option is to slow the production rates and still procure the revised number of airplanes but over a longer period. This increases the base year dollar estimate of total program cost because the contractors' overhead must be supported over a longer period of time. It increases the then year estimate of total program cost even further because the stretched out outlays will have a longer exposure to inflation.

The F/A-18 program already has experienced some cost growth due to schedule variance, but it has not been large relative to other categories. Additionally, fleet force requirements will constrain production stretch outs. Cost growth due to future schedule is not expected to be significant.

4. Future Engineering Change

The F/A-18 development flight test program is nearing completion; technical deficiencies have been identified; corrections have been conceived and incorporated; and in most cases, the corrections have been successfully evaluated. The production design is becoming firm. This being the case, engineering change is not expected to yield significant future cost growth.

5. Future Estimating Variance

It was previously shown that estimating variance constituted the largest F/A-18 variance category. It was further

shown that approximately one-half of this category represented cost growth due to unrecognized inflation due to the Office of the Secretary of Defense estimates of inflation being lower than the inflation actually experienced. The other half of F/A-18 estimating variance resulted from an overly optimistic development estimate of program cost.

a. Unrecognized Inflation

Unless the Office of the Secretary of Defense and the Navy change policy in order to realistically recognize inflation in weapon system acquisitions, estimating variance will continue to increase, and will represent a significant contribution to future total program cost growth.

b. Optimistic Development Estimate

Continued realization of an overly optimistic development estimate may also contribute to future cost growth. Consider Figures 36 and 37.

Figure 36 shows a least-squares line fitted to approximate the F/A-18 development estimate, cost-quantity curve.[20] This development estimate, cost-quantity curve was derived without the benefit of actual production experience. This least squares line is of the form

$$C_i = a_o Q_i^b$$

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[20]The development estimate cost quantity curve does not represent a true learning or improvement curve because, among other things, contractor overhead and other fixed cost are included in the function. This contributes to the curvelinear shape (log-log plot).

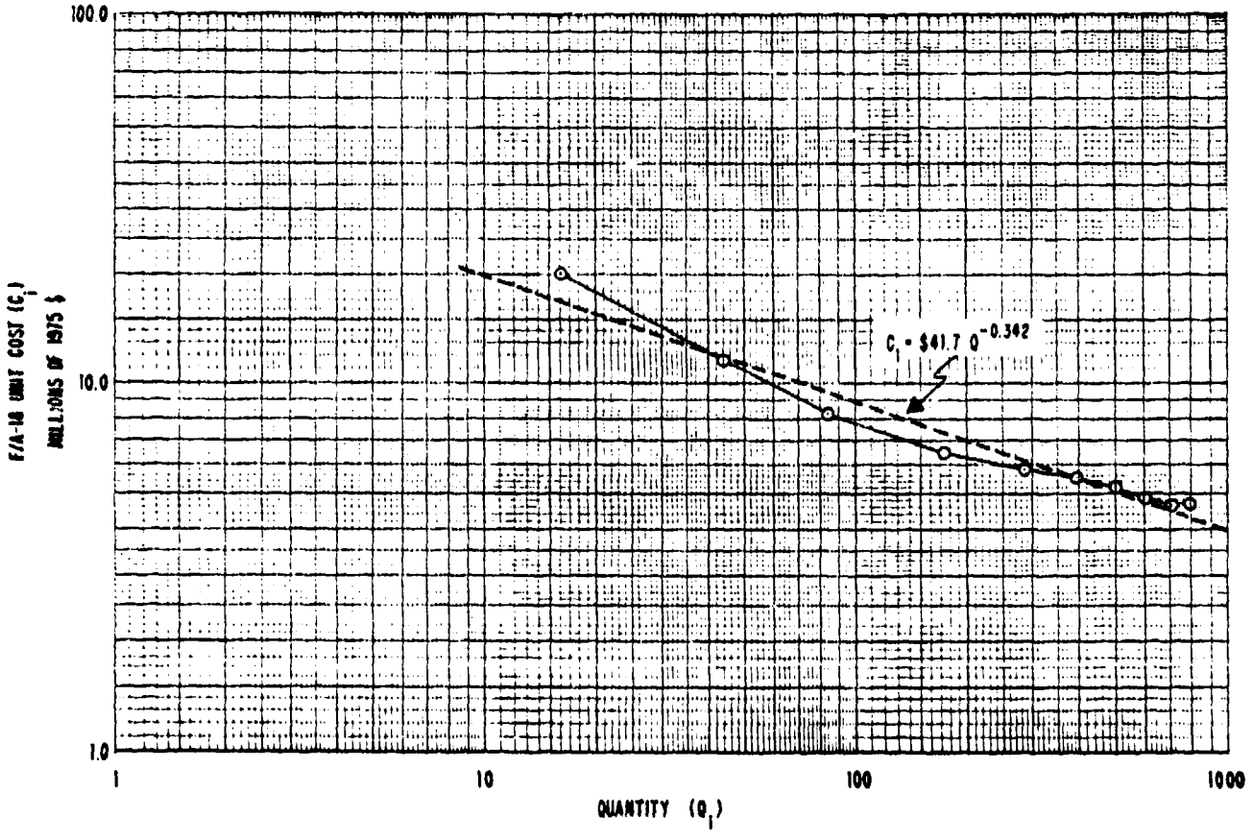

Figure 36. F/A-18 Development Cost-Quantity Curve

where C_i is the cost of the Q_ith unit, and a_o equals 41.7 million 1975 dollars, an equivalent to the theoretical cost of the first production unit, and

$$b = \frac{\ln \text{"slope"}}{\ln 2} = -0.342$$

Therefore the average "slope" = 79 percent. That is, the F/A-18 unit cost after a doubling of the quantity produced would be approximately 79 percent of the former cost.

In December 1979, a current estimate, cost-quantity curve was published in the Selected Acquisition Report. This represented the development estimate, cost-quantity curve

corrected for actual production experience gained during assembly of prototype and test article F/A-18's.

This current estimate, cost-quantity curve and a least squares line approximation to that curve is depicted in Figure 37.

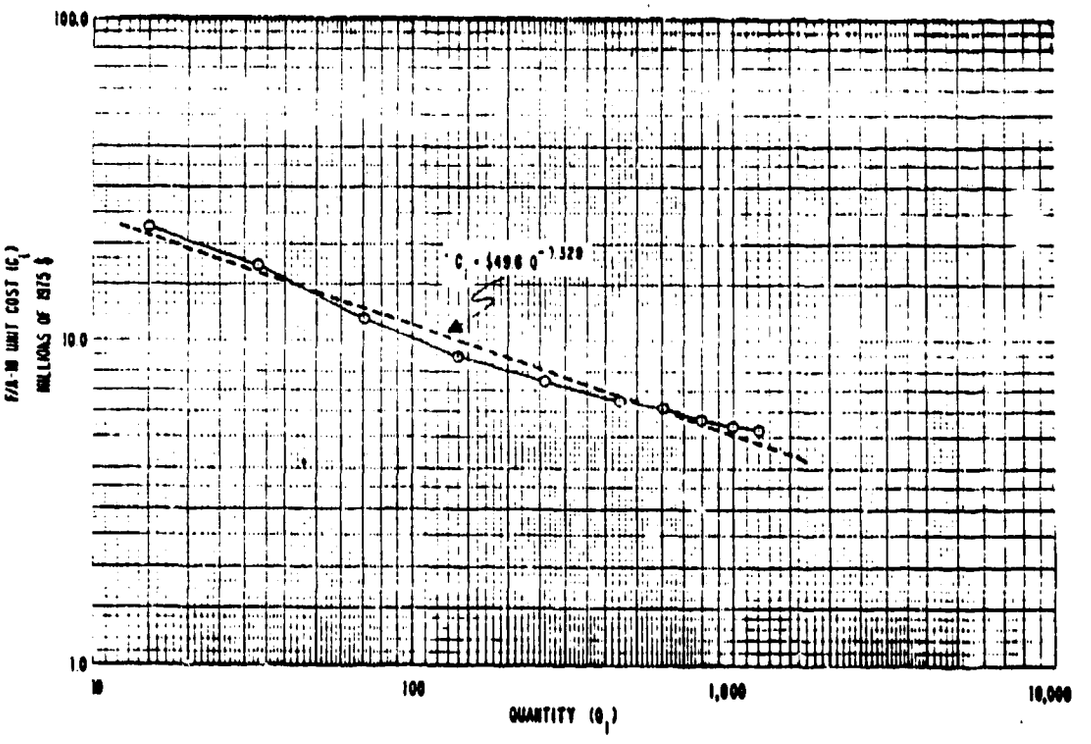

Figure 37. F/A-18 Current Estimate (December 1979), Cost-Quantity Curve

Here the fitted line is also of the form:

$$C_i = a_o Q_i^{\,b}$$

but now a_o = 49.6 million 1975 dollars and b = -0.329; therefore the average "slope" = 80 percent.

By comparing the development estimate, least square line to the current estimate, least squares line the following may be observed:

- The cost of the F/A-18 theoretical first unit was greater than that indicated in the development estimate (a_o for the current estimate (41.7 million 1975 dollars) is greater than a_o for the development estimate (49.6 million 1975 dollars).
- The cost reduction associaced with a doubling of quantity was slightly less than anticipated in the development estimate. (Development estimate "slope" = 79 percent current estimate slope = 80 percent. Recall that the greater the "slope" the slower the cost reduction).

These differences are recognized in the positive estimating variance in the current Selected Acquisition Report, and reflect the overly optimistic development estimate.

Since some actual production experience has now been accumulated, the theoretical cost of the first unit of production (a_o) may be considered fixed. However, since it is still very early in the production phase, the actual "slope" is still not known with high confidence. If the average "slope" of a least-squares line fitted to future current estimates is greater than 80 percent, the development estimate will have further proven to have been overly optimistic. This could result in recognition of significant future cost growth.

Some quantitative insight into the magnitude of possible cost growth may be gained by using the current

least squares approximation to calculate the relative total flyaway cost assuming a slightly higher average "slope."[21]

For example, the results of these analyses are presented in Table 12.

TABLE 12

POSSIBLE COST GROWTH AS A FUNCTION OF COST-QUANTITY CURVE, AVERAGE "SLOPE," WHERE THE RELATIVE MAGNITUDE OF F/A-18 TOTAL FLYAWAY COST IS REFERENCED TO THE DEC. 1979 SELECTED ACQUISITION REPORT,[22] CURRENT ESTIMATE, COST-QUANTITY CURVE FOR UNIT FLYAWAY COST. (Average "slope" = 80 percent.)

"Cost-Quantity Curve Average "Slope"	Relative Magnitude of Total Flyaway Cost for 1366 Production Airplanes
80%	1.00
82%	1.21

This analysis shows the very powerful effect that estimates regarding the cost-quantity curve "slope" can have

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[21]That is

$$\text{Total flyaway cost} = \int_{12}^{1377} a_o Q_i^{\,b} dQ_i = 49.6 \int_{12}^{1377} Q_i \,(\ln \text{"slope"}/\ln^2)\, dQ_i$$

For the Dec. 1979 current estimate, where the average "slope" equaled 80 percent this function equals k, a constant which will be the basis of the relative measurement. (This curve is integrated from 12 through 1377 because the 1366 production airplanes are produced after 11 development (test article) airplanes are produced.) ("Slope" must be expressed in decimal form.)

[22]The cost-quantity curve was not updated in 1980, therefore this analysis focuses on 1979.

on total flyaway cost. As may be seen in Table 12, if the average "slope" of the cost quantity curve turns out to be 82 percent instead of the 80 percent estimated in the December 1979 Selected Acquisition Report; then the total flyaway cost will be approximately 21 percent greater than that reported in December 1979. The total flyaway cost reported in the December 1979 Selected Acquisition Report was 9.3 billion 1975 dollars. A 21 percent increase in total Flyaway Cost would therefore contribute (9.3 billion x 1.21 - 9.3 billion =) 1.95 billion base year dollars to the total program cost.

It can be seen that if the average "slope" of the estimated cost-quantity curve is overly optimistic (i.e., if the contractors unit cost does not decrease as estimated with a doubling of quantity) then significant cost growth will result.

6. Future Support Variance

There is a possibility that increased support cost will be incurred during the F/A-18 program. Interviewees from the Office of the Secretary of Defense generally held forth that the support cost of the F/A-18 program (and almost all other aircraft procurement programs) was underestimated; however, no quantitative estimates were offered. Navy interviewees maintained that the emphasis placed on systems reliability in the F/A-18 program will yield savings in support costs reported in the current selected Acquisition Report are

accurate. Support changes may contribute to future cost growth, but further analysis is beyond the scope of this research.

G. CHAPTER III SUMMARY

This chapter analyzed the elements that make up the F/A-18 acquisition program and the magnitude of cost growth experienced in the program. Next, the selected acquisition report cost variance categories were evaluated and expanded to consider the effects of unrecognized inflation. Then information gained from the calculation of cost growth due to unrecognized inflation was used to further refine the analysis of the magnitude of cost growth. Succeedingly an assessment of the program manager's capability to control cost growth was offered. Finally, areas of possible future cost growth were identified. A more detailed report of general and specific conclusions is presented in the next chapter.

IV. CONCLUSION

This chapter will present general and specific conclusions drawn from the analysis presented in Chapter Three.

A. GENERAL CONCLUSION

This research reveals that the F/A-18 program cost growth is approximately 10 percent when both quantity change and actual inflation are considered, and that the program manager has little control over cost growth. Inflation and possible failure to realize the expected cost-quantity relationships are identified as likely areas of significant future cost growth.

B. SPECIFIC CONCLUSIONS

This section will first specify the major elements that make up the F/A-18 airplane program and will then summarize the analysis of the magnitude of total program cost growth. Next, the major factors which have contributed to the cost growth will be reviewed and the possible controllability of those factors by the program manager will be discussed. Finally, likely areas for future cost growth will be identified.

Before proceeding, two definitions will be reiterated:

Then Year Dollars - The total program cost in then year dollars is the sum of all the annual appropriations required for the program. This sum of required appropriations

reflects assumptions made by the Office of the Secretary of Defense regarding expected inflation rates.

Base Year Dollars - The total program cost in base year dollars is the total value of the program assuming that the purchasing power of the dollar existing in 1975 (when the development estimate was prepared) remained constant throughout the life of the program.

1. Major Elements of the F/A-18 Program

The total cost estimate of the F/A-18 program is reported in the December 1980 Selected Acquisition Report as 38 billion then dollars or 15.8 base year (1975) dollars. Three major elements constitute the F/A-18 program: development, procurement, and military construction cost. The cost and the relative magnitude of each of these elements are presented in Table 13.

TABLE 13
F/A-18 PROGRAM BREAKDOWN AS OF DEC. 1980

Program Element	Cost Estimate (1975 $)	Relative Magnitude (Percentage)
Development	1.6 Billion	10.5
Procurement	14.1 Billion	89.3
Military Construction	0.1 Billion	0.2
Total	15.8 Billion	100.0

a. Development Cost

The F/A-18 development cost reflects all research, engineering and test and evaluation expenses and is independent of the inventory objective. The development phase of the acquisition is nearing completion and most of the 1.6 billion 1975 dollar cost is now a sunk cost.

b. Procurement Cost

The procurement cost mirrors the estimated cost of the planned acquisition of 1366 Flyaway airplanes plus the requested support and spare parts. By far procurement composes the largest portion of F/A-18 total program cost.

c. Military Construction

The military construction cost includes the estimated cost to construction training facilities peculiar to the F/A-18. The military construction element represents a very small proportion of total program cost.

2. Total F/A-18 Program Cost Growth

The magnitude of F/A-18 program cost growth, relative to the development estimate, is presented in Table 14 on a number of different bases.

On a then year dollar basis the total program cost growth reported in the December 1980 Selected Acquisition Report is almost 200%. However, this figure includes the effects of inflation as estimated by the Office of the Secretary of Defense.

TABLE 14

F/A-18 TOTAL PROGRAM COST GROWTH
AS OF DEC. 1980

Basis	Magnitude of Cost Growth (Percent)
Then Year Dollars	194
Base Year Dollars	96
Base Year Dollars Adjusted for Quantity Change	32
Base Year Dollars Adjusted for Quantity Change and Unrecognized Inflation	10

On a base year dollar basis the total program cost growth reported in the December 1980 Selected Acquisition Report is almost 100 percent. This report of the base year dollars cost growth considers the Office of the Secretary of Defense estimates of inflation but does not consider the fact that much of increase in real assets required resulted from the decision to acquire 1366 airplanes vice the development estimate of 800 airplanes.

To make a better comparison between the development estimate of total program cost and the current (December 1980) estimate must be adjusted to take out this quantity increase. On the basis of the base year program cost adjusted for the quantity change the cost growth is 32 percent. However, this

figure still reflects the cost growth due to the inflation over and above that recognized by the Office of the Secretary of Defense.

If the 1.8 billion 1975 dollar cost growth due to this unrecognized inflation is removed, the cost growth may be expressed on a basis where the current estimate has been adjusted for both the quantity change and for the discrepancy between the Office of the Secretary of Defense estimates of inflation and the actual inflation experienced during past years. Thus, on the basis of the base year dollar cost adjusted for the quantity change and for actual inflation, the program cost growth is only 10 percent.

3. F/A-18 Major Cost Growth Factors

The major cost growth factors were analyzed via the variance categories defined in the Selected Acquisition Reports. A quantitative summary is presented in Table 15 and amplifying comments are offered below.

a. Economic Variance

The economic variance represents the increased program cost associated solely with the operation of the economy as estimated by inflation indices issued by the Office of the Secretary of Defense.

b. Quantity Variance

The quantity variance represents the cost associated with the 1978 decision to increase the F/A-18 inventory objective from 800 airplanes to 1366 airplanes.

TABLE 15

F/A-18 COST GROWTH
AS OF DEC. 1980

Variance Category	Percent of Total Program Cost Growth
Economic	24.2
Quantity	27.5
Schedule	4.2
Engineering	1.5
Estimating	34.2 (=15.9+18.3) Note 1
Support	8.4
Total	100.0%

NOTE 1: The 15.9 percent is true estimating error and the 18.3 percent is cost growth due to unrecognized inflation.

c. Schedule Variance

The schedule variance reflects the additional cost associated with changes to the procurement schedule envisioned in the development estimate.

d. Engineering Variance

The engineering variance represents the cost of physical and functional characteristic changes to the system.

e. Estimating Variance

Estimating variance is defined by the Selected Acquisition Report instructions as the change in program cost

due to correction of errors in preparing the development estimate. This definition is misleading because there are really two parts to estimating variance. The first part is true estimating error just as the definition indicates. However, the second part reflects the cost growth due to unrecognized inflation. This cost growth due to unrecognized inflation comes about because the inflation estimates issued by the Office of the Secretary of Defense were lower than the inflation actually experienced by the F/A-18 contractors. The outlays required to make up for inflation, over and above that recognized by the Office of the Secretary of Defense, show up as estimating variance. The F/A-18 cost growth due to unrecognized inflation equates to 1.8 billion 1975 dollars as of December 1980, and constitutes 18.3 percent of the total program cost growth.

The true estimating error amounts to 15.9 percent of the total cost growth. Together the true estimating error plus the cost growth due to unrecognized inflation total to (18.3 + 15.9 = 34.2 percent) the cost growth attributed to estimating variance.

f. Support Variance

The last category, support variance, reflects any changes in program cost associated with spare parts, training and ancillary equipment.

4. Cost Growth Controllable by Program Managers

This research indicates that surprisingly little of the total F/A-18 program cost growth is controllable by the program manager. The economic variance, and the portion of the estimating variance representing the cost growth due to unrecognized inflation are uncontrollable by the manager. The quantity variance reflects changes in inventory objectives determined by the Chief of Naval Operations (among others) and is also uncontrollable by the program manager. The program manager has only some control over schedule variance since he can impact the testing schedule but he has no control over program stretch outs that are a product of the PPBS process. The program manager may have some influence over the support variance in that he may hold down support cost by failing to recognize needed support. Only the program manager in command during the formulation of the development estimate can have any influence over true estimating variance, and this influence may be politically constrained. The program manager has clear control over only engineering variance and this category comprises only 1.5 percent of the F/A-18 total program cost growth. Table 16 summarizes the program manager's control over cost growth.

For example, it may be observed that if every program manager had improved his managerial efficiency by 20 percent, he would have been able to reduce the cost growth actually

TABLE 16

SUMMARY OF PROGRAM MANAGER OPPORTUNITY FOR COST GROWTH CONTROL

Opportunity Total F/A-18 for Program Control?	Percent of Total F/A-18 Cost Growth (Percent)
No	70.0[1]
Some	12.6
Yes	17.4[1]
Total	100.0

Note 1: If control by first program manager (the one responsible for the development estimate) is excluded the "No" category increases to 85.9 percent and the "Yes" category decreases to 1.5%.

experienced by only six percent.[1] If program managers subsequent to the program manager who was responsible for the formulation of the development estimate had improved their managerial efficiency by 20 percent, they would have been able to reduce the program cost growth by only 2.8 percent.[2] Clearly most cost growth is beyond the control of the program manager.

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[1](0.20 x (schedule variance + engineering variance + support variance + true estimating variance) x 100) = (0.20 x (0.042 + 0.015 + 0.084 + 0.159) x 100 = 6 percent.

[2](0.20 x (schedule variance + engineering variance + support variance) x 100) = (0.20 x (0.042 + 0.015 + 0.084) x 100) = 2.8 percent.

5. Possible Future Cost Growth

Two possible areas of major future cost growth are identified in the analysis presented in Chapter Three. The areas are associated with economic variance and estimating variance.

Data presented in Chapter Three clearly shows that the inflation estimates issued by the Office of the Secretary of Defense are generally lower than the "actual" inflationary experience of the aerospace industry. This is noted to be true for political reasons because Government believes that recognition of more realistic estimates might imply tacit approval for higher rates of inflation. This phenomenon of unrealistically low Office of the Secretary of Defense estimates of inflation is not expected to change. Therefore, economic variance and the cost growth due to unrecognized inflation that is included within estimating variance are expected to continue to grow, and significant, future cost growth is likely to result.

True estimating variance may also continue to grow. A least squares approximation to the development estimate, cost-quantity curve shows a 79 percent improvement rate. When the cost-quantity curve is updated based on early production experience the average improvement rate estimate is adjusted to 80 percent. The analysis presented in Chapter Three shows that program cost is very sensitive to the estimated cost-quantity relationship. Specifically, an example was offered

that showed that if the F/A-18 average improvement rate degenerates two percent to 82 percent, the total flyaway cost may be expected to increase as much as 21 percent.

6. Summary

The F/A-18 program cost growth does not appear to be excessive once adjustments are made for the increased inventory objectives and for actual inflation. Little of the program cost growth was controllable by the program manager. Inflation was the major contributor to cost growth and its contribution is expected to continue to increase during future program years. The estimate of total program cost is very sensitive to assumptions made with regard to cost-quantity relationships. Failure to experience the expected reductions in cost associated with increased production quantity could yield significant future cost growth.

APPENDIX A

THE DEPUTY SECRETARY OF DEFENSE

WASHINGTON D.C. 20301

April 30, 1981

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARIES OF DEFENSE
ASSISTANT SECRETARIES OF DEFENSE
GENERAL COUNSEL
ASSISTANTS TO THE SECRETARY OF DEFENSE

SUBJECT: Improving the Acquisition Process

On 2 March 1981, I directed a 30-day assessment of the Defense acquisition system with the priority objectives of reducing cost, making the acquisition process more efficient, increasing the stability of programs, and decreasing the acquisition time of military hardware. The report, delivered to me on 31 March 1981, provided many specific recommendations and posed a number of major issues for decision.

I have discussed the report with the Steering Group, the Joint Chiefs of Staff, the Service Secretaries, and the Under Secretaries and selected Assistant Secretaries of Defense. Based on the report and those meetings, the Secretary and I have decided to make major changes both in the acquisition philosophy and the acquisition process itself. We are convinced that we have now a historic and unique opportunity to significantly improve the Defense acquisition system. We ask for your cooperation and assistance in carrying out these decisions.

The acquisition decisions are recorded in detail in the attachments to this memorandum. I would like to highlight here the major decisions and their implications for DoD in the following paragraphs.

DoD Acquisition Management Philosophy

The DoD management philosophy that I described in my 27 March 1981 PPBS decision memorandum also applies to the acquisition policy and process. Through controlled decentralization, subordinate line executives will be held accountable for the execution of policy decisions and programs as approved. The review of the acquisition process is a good example of participative management where the Services and other DoD staffs, working together, have jointly agreed on

what should be done. All points of view were considered prior to decision. Now that decisions are made, the Secretary and I expect full support of DoD staffs and the Services in implementation.

I affirm the following acquisition management principles:

1. We must improve long-range planning to enhance acquisition program stability.

2. Both OSD and the Services must delegate more responsibility, authority and accountability for programs; in particular, the Service program manager should have the responsibility, authority and resources adequate to execute efficiently the program for which he is responsible.

3. We must examine evolutionary alternatives which use a lower risk approach to technology than solutions at the frontier of technology.

4. We must achieve more economic rates of production.

5. We must realistically cost, budget, and fully fund in the FYDP and Extended Planning Annex, procurement, logistics and manpower for major acquisition programs.

6. Readiness and sustainability of deployed weapons are primary objectives and must be considered from the start of weapon system programs.

7. A strong industrial base is necessary for a strong defense. The proper arms-length relationships with industry should not be interpreted by DoD or industry as adversarial.

DoD-OMB and Congress

Many of the decisions announced in this memorandum can be implemented within DoD's legislative authority. Some decisions need to be coordinated with OMB. A number of recommendations will need Congressional action before final implementation can take place. In those latter cases, we will work closely with appropriate Congressional committees and their staffs to explain and justify our recommendations for changes to legislative requirements.

DoD-Industry Relationship

While DoD should be tough in contract negotiations as part of the buyer-seller relationship, this does not mean that relationships between management and industry should necessarily be adversarial. Industry and government have a shared responsibility and must assume a new spirit of

cooperation. A healthy, innovative, and competitive industrial capability is a primary national objective. I direct all top DoD management, in OSD, in JCS, and in the Services, to ensure this is understood at all levels.

Economies, Efficiencies and Savings

A primary objective in streamlining the DoD acquisition process is reducing costs. All DoD staffs and Service managers should keep this uppermost in their minds. We all must be more aggressive and imaginative in looking for ways to save money throughout all phases of the acquisition process. I look to each of you to use your enhanced authority to bring about major savings and improved methods of operation.

Decisions to Improve Acquisition Policy and Process

The Secretary and I are determined to reduce substantially cost overruns, deploy adequate quantities of needed systems that are operationally effective and ready, and do this in the shortest possible time. We are convinced that the actions directed in the attachment will significantly contribute to achieving these objectives. The major decisions for improvement can be summarized in four categories:

Reduce Acquisition Cost

- Increase program stability by fully funding R&D and procurement at levels sufficient to ensure efficient cost, supportability and schedule performance, and minimizing changes to the approved program.

- Implement multi-year procurement to improve production processes, increase economy-of-scale lot buying, decrease financial borrowing costs and reduce administrative burden in contracting.

- Reduce administrative costs by simplifying procedures, seeking relief from costly legislative requirements and reducing the number of DoD regulations and directives.

- Encourage capital investment to increase productivity in the defense industry by improved contracting, more reasonable risk sharing, and increased incentives.

- Promote Services use of economic production rates to reduce unit costs and decrease acquisition time.

- Require Services to budget to most likely cost to reduce cost overruns and provide stability.

Shorten Acquisition Time

- Implement Preplanned Product Improvement to reduce unit costs and decrease acquisition time.

- Provide adequate "front end" funding for test hardware.

Improve Weapons Support and Readiness

- Stress acquisition strategies that provide incentives to contractors to attain reliability and maintainability goals.

- Establish readiness objectives early in development programs.

Improve the DSARC Process

- Move toward controlled decentralization of the acquisition process to the Services.

- Reduce the data and briefings required by the Services and other DoD staffs.

- Tie the acquisition process more closely to the PPBS.

Implementation of the Decisions

Implementation of the decisions announced in this memorandum is as important as the decisions themselves. Many decisions, even those within DoD's authority, will take time to implement fully. A large number of DoD managers will have to take part on a worldwide basis.

I assign overall responsibility to the Under Secretary of Defense for Research, Engineering and Acquisition for monitoring and follow-up of all decisions in this report. I expect him to establish an appropriate implementing and reporting system. The first report will be submitted to me by the end of May and every month thereafter until further notice.

Both the Secretary and I appreciate the work you and your staffs have provided during this assessment.

Frank C. Carlucci

Attachments

SUMMARY OF MAJOR RECOMMENDATIONS AND ISSUES FOR DECISION

RECOMMENDATIONS	IMPACT		REQUIRED ACTION			COORDINATION					
	NEAR TERM (1 YEAR)	LONG TERM	INTERNAL ONLY	OMB OR CONGRESS ALSO	RESPONSIBLE OFFICE	Services	USDRE	ASD(C)	ASD (MRA&L)	ASD (PA&E)	OGC
1. Management Principles	X		X		USDRE	X					
2. Preplanned Product Improvement		X	X		USDRE	X					
3. Multiyear Procurement		X		X	USDRE			X			X
4. Increase Program Stability		X	X		ASD(PA&E)	X	X	X			
5. Encourage Capital Investment to Enhance Productivity		X		X	USDRE	X		X			X
6. Budget to Most Likely Costs	X		X		ASD(C)	X	X			X	
7. Economic Production Rates		X	X		USDRE			X		X	
8. Assure Appropriate Contract Type		X	X		USDRE	X					
9. Improve Support and Readiness	X		X		ASD(MRA&L)	X	X				
10. Reduce the Administrative Cost and Time to Procure Items		X		X	USDRE			X			X
11. Budget Funds for Technological Risk		X	X		USDRE	X					
12. Front End Funding For Test Hardware	X		X		USDRE	X			X		

SUMMARY OF MAJOR RECOMMENDATIONS AND ISSUES FOR DECISION

RECOMMENDATIONS	IMPACT		REQUIRED ACTION			COORDINATION					
	NEAR TERM (1 YEAR)	LONG TERM	INTERNAL ONLY	OMB OR CONGRESS ALSO	RESPONSIBLE OFFICE	Services	USDRE	ASD(C)	ASD (MRA&L)	ASD (PA&E)	OGC
13. Governmental Programs		X		X	USDRE	X		X			X
14. Reduce the Number of DoD Directives	X		X		USDRE	X					
15. Funding Flexibility		X		X	ASD(C)	X	X				X
16. Contractor Incentives to Improve Reliability and Support		X	X		USDRE	X			X		
17. Reduce DSARC Briefing and Data Requirements	X		X		USDRE	X	X	X	X	X	
18. Budgeting for Inflation		X		X	ASD(C)/ ASD(PA&E)	X	X				
19. Forecasting Business Base at Major Defense Plants	X		X		ASD(PA&E)	X					
20. Improve the Source Selection Process	X		X		USDRE	X					
21. Standard Operational and Support Systems		X	X		USDRE	X			X		
22. Provide More Appropriate Design to Cost Goals		X	X		USDRE	X		X			
23. Assure Implementation	X			X	USDRE	X					

SUMMARY OF MAJOR RECOMMENDATIONS AND ISSUES FOR DECISION

ISSUES FOR DECISION	IMPACT		REQUIRED ACTION			COORDINATION					
	NEAR TERM (1 YEAR)	LONG TERM	INTERNAL ONLY	OMB OR CONGRESS ALSO	RESPONSIBLE OFFICE	Services	USDRE	ASD(C)	ASD (MRA&L)	ASD (PA&E)	OGC
A. DSARC Decision Milestones	X				USDRE	X					
Alt. 1: Reduces current four SecDef decisions to three.			X								
Alt. 2: Reduces SecDef decisions to two. (II and III)			X								
*Alt. 3: Reduces SecDef decisions to two. (I' and II')			X								
Alt. 4: Eliminates SecDef decisions; delegates to Service Secretaries.				X							
b. Mission Element Needs Statement	X				USDRE	X					
*Alt. 1: Service submits MENS with POM. SecDef approves MENS by accepting POM.			X								
Alt. 2: Eliminates MENS. Congressional Descriptive Summary would document Milestone 0.				X							
C. DSARC Membership	X		X		USDRE						
Alt. 1: Maintain status quo.											
*Alt. 2: Would include appropriate Service Secretary or Chief as full member.											

* Approved Alternative

SUMMARY OF MAJOR RECOMMENDATIONS AND ISSUES FOR DECISION

ISSUES FOR DECISION	IMPACT		REQUIRED ACTION			COORDINATION					
	NEAR TERM (1 YEAR)	LONG TERM	INTERNAL ONLY	OMB OR CONGRESS ALSO	RESPONSIBLE OFFICE	Services	USDRE	ASD(C)	ASD (MRA&L)	ASD (P&E)	OGC
D. Defense Acquisition Executive *Alt. 1: Would retain USDRE as DAE. Alt. 2: Would designate DepSecDef as DAE.	X		X		USDRE						
E. DSARC Review Criteria Alt 1: Continues present system. *Alt 2: Doubles $ guidelines for major systems to $200M RDT&E and $1d Procurement in FY 80 $.	X		X		USDRE						
F. DSARC-PPBS Decision integration Alt 1: Continue present practice. *Alt 2: Provide that DSARC reviewed programs be accompanied by assurance that sufficient resources are in FYDP and EPA to execute the recommended program. DSARC review would certify program ready for next stage. Alt 3: Have DRB assume DSARC functions.	X		X		USDRE	X		X			

*Approved Alternative

SUMMARY OF MAJOR RECOMMENDATIONS AND ISSUES FOR DECISION

ISSUES FOR DECISION	IMPACT		REQUIRED ACTION			COORDINATION					
	NEAR TERM (1 YEAR)	LONG TERM	INTERNAL ONLY	OMB OR CONGRESS ALSO	RESPONSIBLE OFFICE	Services	USDRE	ASD(C)	ASD (MRA&L)	ASD (PA&E)	OGC
G. Program Manager Control of Support Alt 1: Would continue present system. Alt 2: Services submit support resource requirements and readiness objectives with POM for systems entering early production. *Alt 3: Same as 2 but gives Program Manager more influence over support recources, funding and execution.	X		X		ASD(MRA&L	X	X				
H. Improve Reliability and Support *Alt 1: Requires early decision on system support approach, objectives and resources, and incentives to balance risks in reliability and support. Alt 2: Does not require up-front efforts to reduce risks. Shifts focus to fixing problems by subsequent re-design of hardware and incorporation of fixes.	X		X		USDRE	X			X		

*Approved Alternative

Recommendation 1

MANAGEMENT PRINCIPLES

The Steering Group recommends that the Deputy Secretary of Defense reaffirm the following major acquisition management principles:

1. An improved statement of long-range Defense policy, strategy and resources will be provided to the Services in order to establish a framework for military objectives, goals, and mission planning to enhance program stability.

2. Responsibility, authority and accountability for programs should be at the lowest levels of the organization at which a total view of the program rests.

3. Service Program Managers should have the responsibility, authority, resources, and guidelines (goals and thresholds) adequate to efficiently execute the program. This should include the system specific acquisition strategy for attainment of the required operational and readiness capability, and appropriate flexibility to tailor the acquisition strategy to estimates of the development priorities and risks.

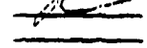
4. Evolutionary alternatives which use a lower risk approach to technology must be examined when new programs are proposed. Solutions at the frontiers of technology must provide an alternative which offers an evolutionary approach. Pre-planned Product Improvement (P^{3}I) should become an integral part of the Acquisition Strategy.

5. Achievement of economic rates of production is a fundamental goal of the acquisition process.

6. The Services should plan to realistically budget and fully fund in the FYDP and Extended Planning Annex (EPA) the R&D, procurement, logistics and manpower costs at the levels necessary to protect the acquisition schedule established at program approval points, and to achieve acceptable readiness levels.

7. Improved readiness is a primary objective of the acquisition process of comparable importance to reduced unit cost or reduced acquisition time. Resources to achieve readiness will receive the same emphasis as those required to achieve schedule or performance objectives. Include from the start of weapon system programs designed-in reliability, maintainability and support.

8. The proper "arms-length" buyer-seller relationship should not be interpreted by government or industry as adversarial. The DoD should be tough in contract negotiations. But weapons acquisition should be managed on a participating basis using industry as a full constructive team member. A strong industrial base is necessary for a strong defense.

Approved: 
Idea Needs More Development:
I Need More Information:
Disapproved:

Recommendation 2

PREPLANNED PRODUCT IMPROVEMENT

A revolutionary system development approach which uses new and untried technology to meet a military threat can offer dramatic potential payoffs, but frequently ends up with large cost increases and schedule slippages.

An evolutionary approach offers an alternative which minimizes technological risk, and consciously inserts advanced technology through planned upgrades of those deployed subsystems which offer the greatest benefits. In this manner the lead time to field technological advances can be shortened while an aggressive scheduling of fielded performance improvements can be expected during the service life of the systems. This concept is called Preplanned Product Improvement (P^3I), and is commonly used in commercial industry.

Recommendation - Most new and existing systems should be partitioned for performance growth through the application of sequential upgrades to key subsystems in order to reduce development risk, and take best advantage of technological advance.

Advantages - Can reduce acquisition time, reduce development risk and cost, and enhance fielded performance through the deployment of upgrades. A revolutionary approach can always be adopted when the demands of the threat or other compelling military needs require such an approach.

Disadvantages - The performance needed to meet a critical threat may dictate the use of distant technology, but the factors involved in such a decision are seldom incisive. Therefore, the choice between alternatives is not likely to be absolutely clear.

Action Required:

- USDRE, working with the Services, develop within 30 days a plan for implementing Preplanned Product Improvement including definitions and criteria for application.

- USDRE request the Services to evaluate ongoing programs to determine potential for payoff from the application of preplanned product improvement, and to present results at the next DSARC.

- USDRE assure Services have fixed the responsibility for review of opportunities for product improvement after any system reaches the field, and to develop a product improvement plan.

Approved: 2
Idea Needs More Development: ____
I Need More Information: ____
Disapproved: ____

Recommendation 3

MULTIYEAR PROCUREMENT

Recommendation: Encourage extensive use of multiyear procurement based upon a case-by-case benefit/risk analysis.

Advantages: Multiyear procurement could result in average dollar savings of 10 to 20% in unit procurement cost through improved economies and efficiencies in production processes, economy-of-scale lot buying, decreased financial borrowing costs, better utilization of industrial facilities, and a reduction in the administrative burden in the placement and administration of contracts. In addition, the stimulated investment in production equipment will result in lower-defect, higher quality products. The market stability will also enhance the continuity of subcontractor supply lines and thereby decrease acquisition time. Surge capability will also be improved.

Disadvantages: This funding technique fences in money and commits future Congresses. If used to excess, it would significantly reduce the flexibility of the Secretary of Defense to respond to unforeseen changes in the external threat. If a multiyear procurement was used to lock in a border line program, costs would be increased if the program was cancelled. In order to avoid these potential disadvantages, the following criteria are recommended as general guidelines to screen potential multiyear candidates: (1) significant benefit to the Government; (2) stability of requirements, configuration, and funding; and (3) degree of confidence in cost estimates and contractor capabilities.

Action Required:

a. General Counsel must respond in writing to Congressman Daniel's Bill HR 745.

b. USDRE and ASD(Comptroller) should brief Appropriation and Armed Services Congressional Committees on recommended multiyear procurement procedures and concepts.

c. USDRE should prepare special policy memorandum to the Military Departments for SecDef signature defining procedures and requesting identification of potential FY 83 multiyear procurement candidates.

d. USDRE and ASD(Comptroller) should modify DoD Directive 7200.4 and the Defense Acquisition Regulation (DAR) and should interface with OMB to modify Directive A-11 as required.

e. SecDef will present FY 83 President's Budget containing multiyear candidates.

Approved: 2
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 4

INCREASE PROGRAM STABILITY IN THE ACQUISITION PROCESS

Program instability is inherently costly in both time and money. The 47 major programs covered by the December 31, 1980, Selected Acquisition Reports (SARs) reflected total cost growth of 129 percent over the Milestone II estimates. Reasons for growth are economic or inflation (27 percent), quantity changes (26 percent), estimating changes (18 percent), schedule changes (15 percent), support changes (7 percent), engineering changes (5 percent), and other changes (2 percent). Forty one (41) percent of all cost growth is due to quantity and schedule changes.

Of the 47 programs, 19 have had quantity increases, 20 quantity decreases, and 8 are unchanged. Schedule changes have resulted in reduced costs on 4 programs and increased costs on 41. The most common cause for these changes is financial. The budget levels and relative priorities of competing programs force tough decisions to terminate programs, reduce the number of weapons, stretch the development program, delay planned production or stretch the planned buy.

Recommendation: SecDef, OSD and Services should fully fund the R&D and procurement of major systems at levels necessary to protect the acquisition schedule established at the time the program is baselined, currently Milestone II. Limit stretch-outs due to funding constraints (except when mandated by the Secretary or Congress). Establish procedures which will phase the scheduling of sequential milestones so that manpower "peaks and valleys" can be minimized consistent with balancing the risks. In general, only changes which are directed by changed requirements or development problems should be made.

Advantages: Reduces costs and saves time by stabilizing schedules, quantities, and production rates. Will enhance the ability to plan force modernizations.

Disadvantages: Budget flexibility will be reduced.

Action Required: SecDef directs that during program and budget reviews by OSD (DRB) the Service Secretaries must explain and justify differences between program baselines established at Milestone II and the quantity and funding in the program or budget under review.

ASD(C) and ASD(PA&E) include above direction in FY-83 POM and Budget Guidance.

Approved: 2
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 3

ENCOURAGE CAPITAL INVESTMENT TO ENHANCE PRODUCTIVITY

Productivity in the defense sector of the U.S. economy has been lagging, in large part because of low levels of capital investment compared to U.S. manufacturing in general. Cash flow problems, tax policy, high interest rates, and low return on investment (ROI) tend to limit available investment capital. The industry views low profits and program instability as precluding investment in capital equipment. This situation has two major implications: a tendency to shift from defense to commercial business, and a decrease in funds available for facilitization.

Recommendation: Encourage capital investment.

Advantages: Will increase long-term investments which should lead to lower unit costs of weapons systems. Increase productivity.

Disadvantages: Earlier Government disbursements. Some reduction in tax revenues.

Action Required: USDRE should have the prime responsibility to implement the following actions working closely with General Counsel, Legislative Affairs, and the Service Material Commands.

a. General Counsel should support legislative initiatives to permit more rapid capital equipment depreciation and to recognize replacement depreciation costs by amending or repealing Cost Accounting Standard (CAS) 409, "Depreciation of Tangible Assets."

b. Structure contracts to permit companies to share in cost reductions resulting from productivity investments. Modify the Defense Acquisition Regulation (DAR) profit formula. Allow for award fees inversely proportional to maintainability costs.

c. Increase use and frequency of milestone billings and advanced funding. Expedite paying cycle.

d. Provide for negotiation of profit levels commensurate with risk and contractor investment; ensure that recent profit policy changes are implemented at all levels.

e. Instruct the Services of the need to grant equitable Economic Price Adjustment (EPA) clauses in all appropriate procurements. Contract price adjustments made in accordance with EPA provisions should recognize the impact of inflation on profits. Ensure that these clauses are extended to subcontractors.

f. Increase emphasis on Manufacturing Technology Programs.

g. Provide a consistent policy which will promote innovation by giving contractors all the economic and commercial incentives of the patent system. Provide policies to protect proprietary rights and data.

h. General Counsel should work to repeal the Vinson-Trammell Act.

Approved: ✓
Idea Needs More Development: ____
I Need More Information: ____
Disapproved: ____

Recommendation 6

BUDGET TO MOST LIKELY COSTS

Intentionally low initial cost estimates are a prime contribution to apparent cost growth. Program costs are sometimes purposely understated either because DoD is forcing a program to fit available funding rather than the funding it takes to do the job, or because the contractors are purposely lowering their cost estimates in order to win a contract with hopes of recovering costs on follow-on contracts. Either practice is referred to as "buying in." When the actual costs become apparent, DoD is severely criticized for cost overruns and there are insufficient funds available to procure at economic production rates. Also, the negotiated contract cost does not include future engineering changes or post-contract award negotiations which can drive costs higher.

Recommendation: Require the Services to budget to most likely or expected costs, including predictable cost increases due to risk. Provide incentives for acquisition officers and industry to make and use realistic cost estimates.

Advantages: Less cost growth. More realistic long-term defense acquisition budget. Increased program stability.

Disadvantages: Difficulty in determining if a contractor is providing realistic estimates. Political difficulty in rejecting bids that project prices lower than costs. Difficult to budget funding greater than publicly-known contractual funding.

Action Required: ASD(C) require the Services to budget to most likely or expected costs including predictable cost increases due to risk, instead of the contractually agreed-upon cost. USDRE and the Services provide incentives for acquisition officers and contractors to accurately project costs, including financial incentives and performance evaluation considerations to DoD personnel, and profit incentives to industry to reduce costs.

Approved: X
Idea Needs More Development: ____
I Need More Information: ____
Disapproved: ____

Recommendation 7

ECONOMIC PRODUCTION RATES

The cost and time needed to put a weapon system into the field can be reduced by establishing and sustaining economic rates of production (i.e., the rate at which unit cost doesn't decrease significantly with further rate increases). Tight budgets and strong competition between programs have forced many programs to accept funding levels in the budget which will not sustain an economic rate of production.

A commitment to economic production rates cannot rule out sound arguments for lower (or higher) rates. For example, the Services may wish to stretch a program over a number of years in order to preserve a warm production base to permit rapid mobilization to meet a crisis or war. However, this requires stockpiling of materials, parts and subsystems to be effective.

Recommendation: Services must use economic production rates in their program and budget requests, or explain and be prepared to defend the reason why a different rate was selected.

Advantages: Save time and reduce cost of acquiring new systems.

Disadvantages: Will buy out the total system faster (shorter production run for a given quantity) with peak funding competing with other systems, possible workload fluctuations in certain industries with occasional dead time and possible erosion of the industrial base. Can increase cost of correcting support problems.

Action Required: Secretary of Defense establish policy requiring Services to fund programs at economic rates or justify any differences during budget reviews by OSD and the DRB. USDRE and ASD(C) include this requirement in the FY 83 program and budget guidance.

Approved: 
Idea Needs More Development: _____
I Need More Imformation: _____
Disapproved: _____

Recommendation 9

ASSURE APPROPRIATE CONTRACT TYPE

Industry has repeatedly, over a long period, expressed serious concerns about the recurring use of the wrong type of contract. In particular, fixed price contracts are frequently employed for RDT&E and early production, which have legitimate cost uncertainties. This leads to a high risk situation for the contractors and to cost overruns for DoD. Current DoD policies and regulations give guidance as to the use of appropriate contract types; however, this guidance is not being followed in the field.

Recommendation: Give the Program Managers the responsibility to tailor contract types to balance program needs and cost savings with realistic assessment of an acceptable balance of contractor and government risk. Recommendation 1/Management Principle 3 states that the Program Managers be given the authority to determine the specific acquisition strategy.

Advantages: Precludes a company from being forced to assume cost risk beyond their financial ability.

May increase competition if contractor risks are recognized.

Gives the Program Managers more flexibility to accommodate program needs.

Disadvantages: Government assumes more cost risk.

Action Required: USDRE establish an OSD, Service, Industry working group to develop an implementation plan to ensure that appropriate contract types are used. USDRE and the Service Secretaries ensure that Program Managers have the responsibility for determining the appropriate contract type. USDRE should ensure that the regulations are clear on this point.

Approved: 2
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 9

IMPROVE SYSTEM SUPPORT AND READINESS

As a result of recurring problems with weapons system support, the recent revision of acquisition policies includes a major emphasis on support issues, including reliability, maintenance, spares, test equipment, and maintenance manpower. These recent policies are generally sound, are not directly influenced by the major acquisition process options presently under consideration and can be undertaken under any option.

To be effective the policies require Secretary of Defense commitment. The need for this specific commitment results from the competition among the conflicting objectives of high performance, lower cost, shorter schedules, better reliability and maintenance, and support.

Recommendation: Establish readiness objectives for each development program to include estimates of the readiness level to be achieved at early fielding and at maturity. Implement acquisition policy establishing "designed-in" reliability and readiness capabilities. The implementation must emphasize the objectives of shortening the overall time to deliver equipment to the troops which meet mission and readiness needs: the need for improved estimates of the R&D and support resources required: and additionally, ask that some force elements(s) be targeted for a major improvement in designed-in support capability to be less dependent on a support tail.

Advantages: Clarifies that improvement in readiness is a major objective of the Administration, and that implementation must take place.

Disadvantages: Will require additional technical effort and resources early in acquisition programs.

Action Required: MRA&L draft SecDef policy letter to be issued within thirty days, reaffirming weapons support policy and objectives, and tasking the Services to develop implementing guidelines, including procedures for addressing support early in acquisition programs.

Approved: DR
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 10

REDUCE THE ADMINISTRATIVE COST AND TIME TO PROCURE ITEMS

In 1974, less stringent requirements were established for DOD Contract procedures associated with purchases under $10,000. The purpose was to reduce both the time and paperwork costs to a level commensurate with the value of the item being purchased. Over the years the tendency of a bureaucracy to take precautions has expanded the paperwork associated with a procurement, and inflation has reduced the purchasing power of the dollar until the $10,000 item of 1974 would cost almost twice that much to purchase today.

A similar inequity exists in the administrative procedures governing contract funding execution. Department of Defense and Service procedures place numerous administrative requirements on the obligation of funds. They provide unnecessarily cumbersome safeguards for the public interest, to a certain extent thereby, thwarting that interest. There is also a general tendency to apply the most burdensome procedures, even if administrative shortcuts are allowed. The DoD is motivating its contract and fund administrators to avoid the least possibility of criticism rather than to use economic procedures.

a. Recommendation: Raise the $10K limit for purchase order contract use to $25K to accommodate inflation and reduce unnecessary paperwork and review. Letter is enroute from Joint Logistics Commanders to DEPSECDEF recommending change. Proposal is currently in staffing at OMB for inclusion in the Uniform Procurement System (UPS) and as a legislative initiative.

Action Required: DEPSECDEF recommend that OMB (OFPP) initiate change to 10 USC 2304.

b. Recommendation: Raise threshold for contractor costing data input from $100K to $500K to accommodate inflation and reflect current auditing procedures. (Paperwork load is such that only data for contracts over $500K is actually audited today.)

Action Required: DEPSECDEF recommend that OMB (OFPP) initiate legislative change to USC 2306.

c. Recommendation: Raise threshold for Service Secretary review of Contract Determination and Findings (D&F) for RDT&E from $100,000 to $1 million. Current level was set in mid-1960s. Higher level would still cover 90 + % of expenditures (dollars). Higher limit supported by JLC.

Action Required: DepSecDef recommendation to OMB (OFPP) for approval; subsequent change to Defense Acquisition Regulations (DAR).

d. Recommendation: Encourage greater use of class (D&Fs) which allows one D&F to cover multiple contracts. Reduces total volume of contracts which must be reviewed, thus speeding up processing time.

Action Required: USDR&E prepare policy statement encouraging greater use of class D&Fs.

e. Recommendation: Raise reprogramming thresholds from $2M to $10M for RDT&E appropriations and from $5M to $25M for procurement. Thresholds were set 10 years ago with no inflation accommodation. Greatly reduces Service flexibility to answer program.

Action Required: Renew SecDef/DepSecDef efforts to obtain Congressional Committee approval (HASC, SASC, HAC, SAC).

Advantages (all above recommendations): Provides immediate relief from unnecessary paperwork burden. Reduces administrative lead time, which will result in reductions in in-house and industry overhead cost. Supports a far more efficient Government cash flow management.

Disadvantages: Less opportunities for legal reviews.

f. Recommendation: Eliminate the need for non-Secretarial level D&Fs for competitive negotiated contract awards.

Advantages: Reduced paperwork and administrative lead times. In conjunction with recommendation C above, to increase D&F thresholds, the D&F requirement would be considerably reduced.

Disadvantages: Many smaller procurement actions would not be reviewed above program office level.

Action Required: SecDef submit recommended legislation to review public law.

g. Overall Action: USDR&E prepare implementation plan and required SecDef letters within 60 days. Tie cost thresholds to inflation.

Approved: 2
Idea Needs More Development: ___
I Need More Information: ___
Disapproved: ___

Recommendation 11

INCORPORATE THE USE OF BUDGETED FUNDS FOR TECHNOLOGICAL RISK

Material development and early production programs are subject to uncertainties. Program managers who explicitly request funds to address these uncertainties usually find these funds deleted either in the DoD PPBS process, by OMB, or by Congress. Then when such uncertainties occur, undesirable funding adjustments are required or the program must be delayed until the formal funding process can respond with additional dollars.

The Army has initiated, and Congress has accepted, a Total Risk Assessing Cost Estimate (TRACE) to explicitly address program uncertainties in the development of RDT&E budget estimates. The Army is studying the application of this concept to early production cost estimates. The other Services lack a similar concept to justify reserve funds for dealing with developmental uncertainties.

Recommendation: Increase DoD efforts to quantify risk and expand the use of budgeted funds to deal with uncertainty. Encourage all Services to use such budgeting where appropriate.

Advantages: Cost estimates will be more realistic over time. Programs will be more fully funded and overall programs will be more stable.

Disadvantages: Can encourage a more costly treatment of problems that might be solved in other ways (self-fulfilling prophecy). Higher initial program estimates would result in fewer programs within a stated total obligation authority.

Action Required: SecDef emphasize the requirement to evaluate, quantify and plan for risk. USDRE direct all Services to budget funds for risk. In particular, each Service should review the TRACE concept and either adopt it or propose an alternative for their use to USDRE within 60 days.

Approved: 2
Idea Needs More Development: ____
I Need More Information: ____
Disapproved: ____

Recommendation 12

PROVIDE ADEQUATE FRONT END FUNDING FOR TEST HARDWARE

Weapon system development programs often have too few test acticles to allow parallel tests for performance, reliability, etc., and in order to shorten development time without substantially increasing risks. Procurement of too few test articles forces a sequential approach whereby the available test articles are dedicated exclusively to development testing. Consequently, operational and other testing cannot be accomplished concurrently (within acceptable levels of risk) to save time.

In addition to designing for the major performance objectives, increased emphasis should be placed on designing for reliability by providing adequate design margins, while giving full consideration to adequate testing, fault isolation and maintainability. Adequate test hardware should be provided in the program to permit early combined environmental tests of the subsystems and subsequent system tests, to allow iteration of the design using the test-fix test process to achieve early design maturity.

Recommendation: Provide sufficient test hardware to meet the subsystem, system and software engineers' needs to properly engineer and test development of the end item hardware using parallel testing to reduce overall schedule time. The number of test articles must be defined and explained during preparation of Service programs and budgets.

Advantages: Saves time in the total acquisition process by emphasizing reliability up front and eliminating lengthy and costly problem identification and correction effort; also allows realistic concurrent development and operational testing.

Disadvantages: Requires increased front end funding.

Action Required: USDRE ensure that the acquisition strategy identify plans for and funding required to acquire adequate subsystem and system test hardware to reduce overall schedule time and risks.

Approved: X
Idea Needs More Development: ____
I Need More Information: ____
Disapproved: ____

Recommendation 13

GOVERNMENTAL LEGISLATION RELATED TO ACQUISITION

Over the past decade, the acquisition process has become overburdened with governmental legislation and requirements. Individually, these regulations have worthwhile objectives; collectively, they impose a costly and burdensome requirement on industry and the acquisition process.

Recommendation. Seek DoD relief from the more burdensome requirements of governmental regulations.

Advantages: Less cost to contractors in doing business with the Government. Reduce program costs. Simpler contracting procedures. Faster contract awards.

Disadvantages: Reduced benefits which are considered important national goals. Request for relief will certainly spark debates with the various interested groups.

Action Required: USDR&E establish joint OSD and Service team to weigh the impact of the various governmental requirements and regulations on the efficiency and effectiveness of the total DoD acquisition and contracting process. Industry and OMB should participate to the maximum extent possible. A report should be prepared for the DepSecDef within 45 days.

Approved: X
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 14

REDUCE THE NUMBER OF DOD DIRECTIVES

The current acquisition directive refers to 114 (up from 15 in 1971 and 26 in 1977) related directives and instructions. The Services emulate these directives in implementation with their own implementing instructions. There is rarely a challenge to these well-intentioned directions, nor is there a cost-benefit check performed. Program manager and industry initiatives are often stilted by overregulation. With each new directive additional paperwork, manhours and other direct costs are expended in compliance. Congressional, GAO, industry, OSD, and OFPP studies have indicated that contractually imposed management systems and data requirements cost 8 cents out of every contract dollar. With defense contracting approaching $100 billion a year, it means that these management-imposed requirements cost approximately $8 billion per year. A 20% improvement would save $116 million per year.

Recommendation: Reduce the number of directives. Require that the Defense Acquisition Executive be the sole issuer of DoD directives related to acquisition. This would not mean that DAE would draft all such documents, only that DAE would have final review and releasing authority.

Advantages: Coordinates requirements and reduces the issuance of superfluous directives. Will reduce program costs to the extent that directives require reports, data, documentation.

Disadvantages: Adds an additional layer to the process of issuing or revising a directive. Places the DAE in control of directives for areas of acquisition for which he may have little expertise.

Action Required: USDPE establish a joint OSD, Service, Industry team to provide recommendations within 90 days to substantially reduce the number of directives, and the documentation required in contracts.

Approved: JC
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 15

FUNDING FLEXIBILITY

Program continuity requires that we budget for procurement funds more than a year in advance of the actual transition date of major acquisition programs from R&D to procurement. Since most development program schedules are success oriented, sometimes the procurement transition date arrives and the system is not ready to buy. Because procurement funds have been budgeted, there is considerable pressure to proceed with production rather than accept program delay. If the Secretary (and/or Military Departments) had the authority to transfer these procurement funds to R&D to correct deficiencies without the prior approval of OMB and Congress, it could significantly decrease the time involved in resolving program problems. Section 734 of P.L. 96-527 (DoD Appropriation Act) provides a general authority for Transfers, not to exceed $750 million between DoD appropriations. Its use requires a determination by SecDef that such action is in the National Interest and must have prior approval by OMB. Our current reprogramming arrangements with the Congressional Oversight Committee provide that any such transfer is of "special interest of the Congress" and requires their prior approval, in effect, negating the independent use of transfer authority by the Department.

The proposal would require the support of the Oversight Committees and OMB. Ideally, such approval should be included in the general provisions of the Appropriations Act as a subsection of 734. We will have to work closely with Congress to ensure that this authority would apply only to the movement of funds programmed for an individual weapon system, and would not be used to transfer funds between programs.

Recommendation: Obtain legislative authority to transfer individual weapon system Procurement funds to RDT&E.

Advantages: Provides DoD with more flexibility to resolve weapon system funding deficiencies.

Avoids program delays associated with OMB/Congressional review and approval of funding adjustments.

Maintains program stability by enabling program manager to resolve problems within total available acquisition funding of the program involved

Disadvantages: OMB/Congressional visibility occurs after the fact.

Could jeopardize current appropriation and authorization process.

Could jeopardize current reprogramming arrangements with Congress.

May be destabilizing.

Action Required: ASD(C), working with the General Counsel, OMB and Congress establish procedures for DoD approval of the transfer of funds in a given fiscal year from Procurement to RDT&E for an individual weapon system when the Secretary of Defense determines that it is in the National Interest to do so.

Approved: X
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 16

CONTRACTOR INCENTIVES TO IMPROVE RELIABILITY AND SUPPORT

Industry has said that even though there is recently more attention paid to "support" in DoD solicitations, there is a widespread belief that performance and schedule are DoD's principal objectives. There is a need for industry to apply more of their design talents to reducing reliability and support problems. Beyond this a need to improve the identification and specification of maintenance manpower constraints and for industry to include these constraints in the designs.

Recommendation: Acquisition strategies should identify the approaches to incentivize contractor attainment of reliability and maintainability (R&M) goals and reduce maintenance manpower and skill levels. These should include the approach taken in the RFP evaluation, as well as specific awards, incentives and guarantees, such as specific rewards for improving reliability. The Services should develop greater expertise in support related contractor incentives through analysis of experience gained on DoD programs.

Improvements should be developed in the method of projecting critical maintenance manpower skill limitations and translating these into design constraints and objectives for inclusion in RFPs and specifications.

Advantages: Improves reliability and support. Reduces maintenance manpower requirements.

Disadvantages: Incentives other than competition require additional funds.

Action Required: USDRE working with the Services, develop guidelines to include the approaches to incentivize contractors to improve support within 60 days, followed by a USDRE and Service evaluation of incentives within the next year.

USDRE develop with the Services, within one year, improved approaches to translate maintenance manpower skill projections into system design objectives.

Approved: /2
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 17

DECREASE DSARC BRIEFING AND DATA REQUIREMENTS

During recent years there has been a growing tendency to centralize the decision process within the DoD. This practice has multiplied throughout the numerous levels of authority in each of the Services, and has complicated the review process. This practice has, in and of itself, lengthened the acquisition cycle; created cost increases due to delays in decisions; confused the authority, responsibility and accountability of the designated Services Managers; and has stifled innovation which could produce program improvements leading to cost savings. The principle of decentralization should be applied to acquisition management.

Recommendation: Emphasize the requirement to achieve appropriate delegation of responsibility, authority and accountability to and within each Service for system acquisition to reduce the time and effort required for DSARC and Service major system reviews.

Advantages: Reduced system cost and shorter acquisition cycles. More efficient reporting by and within the Services. More streamlined program management. More efficient DSARC and other program reviews. Potential elimination of layered management resulting in lean organizations.

Disadvantages: Some risk of losing a thorough functional analysis of the system because of the elimination of more detailed reviews.

Action Required: USDR&E make explicit the changed character and the reduced number of briefings and data for the DSARC review.

Approved: _____
Idea Needs More Development: _____
I Need More Information: _____
Disapprove: _____

Recommendation 18

BUDGETING WEAPONS SYSTEMS FOR INFLATION

Historically, inflation predictions have been lesser than the actual inflation that come to pass. The situation has been most severe in major weapon programs that spend out slowly and extend into those years when inflation estimates have been poorest. The result is that unpredicted inflation has cut heavily into real program by as much as $6 or $7 billion a year. In addition to the serious underfunding of major weapon and other purchases, DoD is charged with poor management because of the amounts of cost growth in current dollars appearing in reports and in the process.

Recommendation: Review various methods and alternatives for budgeting more realistically for inflation.

Required Action: Comptroller and PA&E develop in more detail the various alternatives addressing the inflation issue as related to planning and budgeting for major acquisition programs and provide a decision paper to the Deputy Secretary of Defense within 30 days; discuss draft options with OMB and appropriate Congressional staff.

Approved: 
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 19

FORECASTING OF BUSINESS BASE CONDITION AT MAJOR DEFENSE PLANTS

The business base at key defense plants is not adequately considered in DoD program development. Cross-Service impacts and the effects of non-DoD work distorts business base projections and seriously increases overhead costs. This has caused large cost growth for certain weapons systems. Too little consideration is given to this factor in DoD planning and decision-making.

Recommendation: The Services will increase the effort to coordinate programming information that affects other Service overhead costs at given defense plants. Program offices will provide program projections to plant representatives so that overall business projections can be made available to the Services for planning and budgeting.

Advantages: Better cost estimates and lower cost to the government. Provides more realistic costs and stability.

Action Required: Contract Administration functions will be directed to maintain a business base projection, and government offices will be directed to support this effort and utilize these data in planning and budgeting. The OSD Cost Analysis Improvement Group (CAIG) will maintain a data exchange for the Services to assist in improved forecasting.

Approved: 
Idea Needs More Development: ____
I Need More Information: ____
Disapproved: ____

Recommendation 20

IMPROVE THE SOURCE SELECTION PROCESS

Some DoD competitively-selected contractors have performed poorly. In some instances, source selection criteria do not sufficiently take into account past performance or plans for future phases of a program. Also, the credibility and realism of contractor cost proposals are not always challenged.

Recommendation: Improve the source selection process to place added emphasis on past performance, schedule realism, facilitization plans and cost credibility. De-emphasize the importance of lowest proposed cost. Devote more attention to evaluating contractors' performance during and at the time of contract completion. Provide award fee contract structure to encourage good performance. This both provides an incentive for good performance, and a measure of contractor performance to be used in future source evaluations. Establish quality ratings where possible and ensure these past performance ratings are available for use by source selection personnel.

Advantages: Eliminate poor performers, eliminate proposals that are unrealistically priced, thereby reducing the risk of buy-ins.

Disadvantages: May limit competition. Will be difficult to implement and apply fairly.

Action Required: USDRE modify the source selection directive, DoDD 4105.62, to emphasize the objectives stated above. USDRE establish a DoD system for recording, documenting and sharing contractor performance.

Approved: 2
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 21

DEVELOP AND USE STANDARD OPERATIONAL AND SUPPORT SYSTEMS

New subsystems and support systems are developed that are peculiar to specific weapon systems, yet have many performance features in common with other systems. Use of standard, off-the-shelf subsystems and/or support systems for some of the long lead time items can reduce development time.

Recommendation: Identify and develop standard subsystems and support systems or their technology (independent of weapon systems) to meet projected weapon system needs. Support a program of weapon support R&D to put diagnostic, repair, and logistic technology on the shelf.

Advantages: Earlier deployment with lower risk. Enhanced supportability. Reduction in operating costs.

Disadvantages: Standard systems or technology may not be best match for the weapon system needs. Requires increased funding to implement. Could be overemphasized.

Action Required: USDRE working with the Services submits a proposed program for FY 82 and beyond within six months.

Approved: R
Idea Needs More Development: _____
I Need More Information: _____
Disapproved: _____

Recommendation 22

PROVIDE MORE APPROPRIATE DESIGN TO COST GOALS

Design to Cost (DTC) fee awards are made as a result of paper analysis. There is little or no tie to actual costs in production. DTC incentive fees and awards are payable during and at the conclusion of Full-Scale Development. Award is based on the forecasted average cost for the production quantity.

Recommendation: Provide appropriate incentives to industry by associating fee awards to actual costs achieved during the early production runs.

Advantages: Ties award to "real" achievement. Makes DTC meaningful.

Disadvantages: Changes in program (rates, quantity, inflation, etc.) complicate analysis of results. Longer time between DTC effort and award payment.

Action Required: Insure program managers and contracting officers develop contract terms and procedures to provide for the payment of Design to Cost (DTC) awards and incentives based upon costs actually achieved during early production runs. Base payments on demonstration that initial costs are on track with DTC goal for total forecasted production.

Approved:	2
Idea Needs More Development:	
I Need More Information:	
Disapprove:	

Recommendation 22

ASSURE IMPLEMENTATION OF ACQUISITION PROCESS DECISIONS

The acquisition process has been studied many times by many organizations. Most of the recommendations presented here have been made before. However, few of these recommendations have been implemented. Congress, GAO, OMB, OFPP, industry, and OSD have continuously criticized the Services for not following DODD 5000.1 and DODI 5000.2. A recent Navy acquisition study reviewed the implementation status of past acquisition process studies and found that of 50 recurrent recommendations, some progress is perceived to have occurred in 29 and almost no progress is perceived to have occurred in the remainder.

A difficulty with implementing recommendations regarding the acquisition process is the great number of players involved to make implementation succeed. This requires persistent, intensive, follow-up effort to make sure that the recommendations really do take hold. The most common reason for non-implementation is simply that relentless action on the part of top management is not taken to insure that recommendations are, indeed, implemented. OSD has, in the past, focused a great amount of management attention on policy development and resolution. However, OSD has not monitored implementation of the policies on a program basis.

Since potential decisions could lead to major changes to the process and even to DoD organizations and their roles, it will be difficult for the existing DoD organizations to execute changes without high level attention by the SecDef and DepSecDef. Elimination of the complexity inherent in the current process is masked unless the many different types of changes are considered in terms of the aggregate administrative and reporting load generated.

A fundamental determination which is required for each decision is whether implementation should reflect centralized control under OSD or decentralization to the Services. In selected areas a uniformity of action across Services may be desired.

Recommendation: Ensure that a determined management translates approved recommendations into implementable direction and fixes responsibility so that management has visibility of the actions taken.

Advantages: This plan will not succeed without a well planned, intensive, high visibility, relentless implementation phase. Without this effort, this report will degenerate into another study.

Disadvantages: Implementation will require a priority and time commitment from all levels of management ranging from the SecDef to the Program Manager for a number of years.

Action Required: a. Assign overall responsibility to USDRE for monitoring and follow-up of all decisions made in this report.

b. USDRE will assign a prime responsibility for action on every recommendation and decision in this report. In general, these assignments have been specified under the "Action Required" sections; however, in certain cases specific action responsibilities will be defined in the immediate future.

c. USDRE should consider utilizing a working group containing OSD and Service representatives to assist in implementation.

d. USDRE should consider utilizing a number of creative techniques to translate the intent of these recommendations to all levels. This could include formal training sessions, conferences, video taped training films, articles, and policy letters.

e. Both the SecDef and the DepSecDef must maintain a personal interest in ensuring that the changes are implemented, that there is continuous action to improve the acquisition process, that periodic reviews take place, and that all Services and OSD staff be made aware of the SecDef priority interest on this subject.

Approved: _____
Idea Needs More Development: _____
Need More Information: _____
Disapproved: _____

MAJOR ISSUES FOR DECISION

This section presents for decision the major issues identified in the Defense Systems Acquisition Review.

A. Issue: WHAT SHOULD BE THE SECDEF (DSARC) DECISION MILESTONES?

The current process provides four discrete SecDef decision points. All of the alternatives discussed below retain the current "milestone" process structure. However, all alternatives either de-emphasize or reduce the number of formal OSD level milestone reviews and SecDef decisions. Under some alternatives certain milestone reviews are delegated to the Service Secretaries. The Secretary of Defense decision authority and acquisition policy responsibilities are maintained and exercised through the PPBS process and/or by invoking explicit disapproval of proposed Service program acquisition decisions at any stage in the cycle. There are four alternatives shown schematically on page .

Alternative One (Page D-11) reduces the current four discrete SecDef decision milestones to three (with flexibility for only two) by altering Milestone Zero.

Milestone Zero SecDef review and decision is accomplished through the annual Planning, Programming and Budgeting System (PPBS).

Although Milestone I is retained, a SecDef decision would generally be necessary only when a program requires a significant prototype (Advanced Development) phase. When held, Milestone I documentation would be reduced.

Milestone II and III reviews would continue to be conducted by the DSARC with final approval action by the SecDef. Any pre- or post-Milestone III reviews deemed necessary would be held at the Service level except under unusual circumstances.

- Pro:
  - Reduced administrative burden.
  - Increased flexibility
  - Initial development program reviews and decisions are speeded.
- Con:
  - May be perceived as a lessining of SecDef control.

Alternative Two (Page D-16) reduces the number of formal SecDef DSARC reviews to Milestones II and III.

Milestone 0 would be reviewed by OSD during PPBS as in Alternative One above.

Milestone I would be delegated to the Service Secretaries. SecDef authority and oversight is maintained through notification of Service decisions with veto/disapproval authority if necessary.

Milestones II and III receive a full DSARC review and DSARC approval.

- Pro:
  - Further delegation of program responsibility and reduction in administrative burden.
  - Front-end process is speeded as in Alternative One.
- Con:
  - Further reduction in SecDef control over acquisition of major programs at front-end; may restrict SecDef ability to redirect due to program momentum.
  - May not be considered proper implementation of A-109 with regard to Milestone I (A-109 requires SecDef to retain decision authority at the four Milestone Decisions).

Alternative Three (Page D-19) reduces the SecDef decision milestones to two, but ensures full SecDef involvement in major program initiation, and improved program definition for program go-ahead. The first decision point, "Requirements Validation: (equivalent to combination of Zero and One), serves as a full DSARC/SecDef review and approval of major program initiation including threat, weapons concept, risk and schedule, readiness, and affordability goals. At this point a specific "not-to-exceed" dollar threshold is established which sets the funding to carry the program through Concept Validation and early Full-Scale Development activity up to the second decision point, "Full-Scale Development and Production." The goals to be achieved by, and the timing of the second SecDef decision point are defined at the first decision point.

The Program Go-Ahead, second SecDef decision point, occurs somewhat later than Milestone II in a "normal" program schedule, and it is selected to coincide with Preliminary Design Review. SecDef retains source veto/disapproval of a Service proposed action and program plans which shall include Full-Scale Development and Production, the program plan for Test and Evaluation, Support and Readiness, and the total acquisition strategy.

The production program review is delegated to the Service Secretary if there are no major changes to the program approved at the second decision point by the SecDef.

- Pro:
  - The administrative burden is reduced by fewer OSD level reviews.
  - The review levels are linked more closely to major expenditure increases.
  - Program commitment is delayed until program technical, performance and cost factors are more accurately determined.
  - Provides more efficient transition between development and production.
- Con:
  - Same Cons as above; in addition the divergence from A-109 language is more acute
  - No separate SecDef production decision required.

B. Issue: SHOULD MENS BE ELIMINATED/REVISED?

Problem: The Mission Element Need Statement (MENS) is an internal DoD document used to support the SecDef decision at Milestone 0. The MENS is required by DoD implementation of OMB Circular A-109 (1976) requirements to state needs in terms of mission and that SecDef should certify the need. The MENS was to be 5 pages or less. In practice staffing has increased and detailed justification information often requested by OSD has contributed directly to perceptions of growth in the "front end" of the acquisition cycle. There are 30 MENS currently approved.

Alternative One would require submission of the MENS (shortened or as currently required) no later than with the Service POM thus linking the acquisition and PPBS process. SecDef approval of MENS would be by accepting POM in the absence of specific disapproval.

- Pro: - Consistent with reduced SecDef review options.
  - Better integration of acquisition and PPBS processes as "new starts" would be reviewed in the context of the full Service/DoD budget formulation process.
  - SecDef decision authority retained, but exercised by exception in the budget process.
- Con: - Some reduction in SecDef visibility and influence over preliminary program plans.

Alternative Two would eliminate MENS document entirely; Congressional Descriptive Summary (and other POM documentation already required) would document Milestone 0.

- Pro: - Reduced paperwork, simplified program documentation.
- Con: - MENS has been given considerable visibility in OFPP, OMB, and GAO, could be viewed as circumvention of A-109 though MENS not specifically required by A-109.

Action Required: USDRE revise DoD Directive 5000.1/DoD Instruction 5000.2 appropriate for alternative selected.

Decision:

Alternative 1 DC
Alternative 2 _____
I Need More Information _____

C. Issue: SHOULD DSARC MEMBERSHIP BE REVISED?

Problem: Service Secretaries have statutory responsibility for the execution of contractual and financial responsibilities for their departments, yet they are not voting members of the DSARC. Service Chiefs also have no vote although they will be responsible for developing and operating the systems under consideration.

Alternative One would maintain current membership. (USDRE, Chairman; USDP; ASD(C); ASD(MRA&L); ASD(PA&E); Chairman, JCS; plus others in special cases).

- Pro: - Retains DSARC as a SecDef staff advisory council.

- Con: - Could place the DSARC in a position of recommending a position that is contradictory to that of the Service line executive responsible to the SecDef without explicitly reflecting the Service position.

Alternative Two would include the appropriate Service Secretary or Service Chief as full members of DSARC.

- Pro: - Provide SecDef with a broader advisory council.
  - Reduces adversary nature of current procedure.

- Con: - Reduce the independence of the DSARC as OSD advisor to SecDef.
  - Increases the size of the DSARC.

Action Required: USDRE revision of DoD Instruction 5000.2 required.

Decision:

Alternative 1 _____
Alternative 2 ___X___
I Need More Information _____

Alternative Four (Page D-24) eliminates all SecDef decision milestones and delegates total program review responsibility to the Service Secretaries. The DSARC could be invoked at SecDef discretion but generally the SecDef would exercise control and decision authority on a by-exception veto/disapproval basis. Milestone Zero would be conducted through the PPBS process as described earlier.

- Pro: - This alternative goes the furthest toward decentralization and reduction in administrative burden.

- Con: - SecDef direct control of major acquisitions is substantially reduced. Perceived violation of the intent of A-109 as regards agency head responsibility.

Action: USDRE revise DoD Directives 5000.1/2 appropriate to alternative selected.

Decision:

Current: (Four SecDef Milestone Decisions) _____

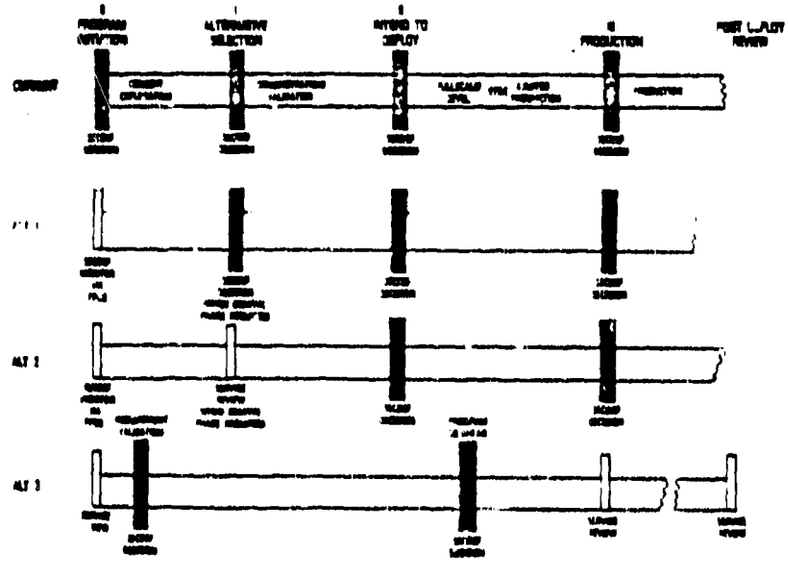
Alternative 1: (Three SecDef Milestone Decisions) _____

Alternative 2: (Two SecDef Milestone Decisions) _____

Alternative 3: (Two SecDef Milestone Decisions) X

Alternative 4: (Zero SecDef Milestone Decisions) _____

ACQUISITION PROCESS ALTERNATIVES



D. Issue: WHO SHOULD BE THE DEFENSE ACQUISITION EXECUTIVE (DAE)?

Problem: Current policy requires that a DAE be designated by the SecDef to be the principal advisor and staff assistant for the acquisition of defense systems and equipment. The USDRE is designated the DAE. However, the scope of the function encompasses procurement of material to support and sustain the force. There is continuing competition between modernization readiness, maintenance of forces and sustainability. The USDRE has primary staff responsibility for force modernization efforts of DoD.

Alternative One would retain USDRE as the DAE.

- Pro: - The USDRE is clearly the OSD executive with the greatest technical knowledge and systems development expertise.

- Con: - Primary USDRE responsibility is developing weapon systems as opposed to operating, maintaining, or supporting the military force.
  - The effort to rationalize and fund competing programs suffers because USDRE could be an R&D proponent himself.

Alternative Two would designate DepSecDef as DAE.

- Pro: - Improved balance between modernizing and operating the force and a more coherent defense program could result from having DepSecDef chair both the DRB and the DSARC.

- Con: - Increases the level of DepSecDef involvement in the acquisition process. USDRE is the OSD technical and system development expert.

Decision:

Alternative 1 JC
Alternative 2 _____.
I Need More Information _____

E. Issue: WHAT SHOULD BE THE CRITERION FOR SYSTEMS REVIEWED BY DSARC?

Problem: Currently, there are over 50 major programs designated for DSARC review. Although dollar thresholds (currently $100M RDT&E or $500M procurement in FY 1980 $) are "guidelines," they are generally the rule of thumb used to select major programs. Major program designation is derived by subjective judgment based upon joint Service participation, estimated funding, manpower and support requirements, risk, politics, and other Secretary of Defense interests.

Alternative One would continue present system.

- Pro: - The current system allows flexibility in designation, and does not force uncontentious programs to become major strictly because of large investment.

- Con: - The largely subjective criteria causes uncertainty, and may be susceptible to an arbitrary designation.

Alternative Two increases dollar guidelines for major system designation to $200M RDT&E and $1B procurement in FY 80 $.

- Pro: - The number of Service DSARCs and DSARC would be reduced approximately 25% while still insuring review of the most expensive major systems.
  - Uncertainty and the opportunity for arbitrary, unnecessary designation are reduced.

- Con: - Reduces number of major systems of significant investment not reviewed at Secretary of Defense level.

Action Required: USDRE revise DoD Directive 5000.1/DoD Instruction 5000.2 if Alternative Two is adopted.

Decision:

Alternative 1 _____
Alternative 2 _____
I Need More Information _____

F. Issue: HOW SHOULD THE DSARC/PPBS DECISION BE INTEGRATED?

Problem: It has been the perception that a DSARC endorsement and subsequent SecDef approval commits the SecDef/Service to fund the program as approved. This has led to confusion as to program status and stability. The DSARC process reviews single programs at significant milestones to determine readiness to proceed to the next phase. It is not feasible in that context to assess the financing of a major program vis a vis other Defense requirements. In contrast, the PPBS addresses all programs within a resource allocation framework without an in-depth review of technical issues and program structure. This "disconnect," the lack of explicit resource commitment (including support and manpower) resulting from a successful DSARC review and subsequent SecDef approval, is frequently cited as a flaw in the acquisition process.

Alternative One continues present practice.

- Pro: - Allows funding decisions during POM/budget development.

- Con: - Fosters program instabilities when DSARC program is not supported in PPBS cycle.
  - May void contract with industry.

Alternative Two resolves the interface problems by providing that programs reviewed by the DSARC will be accompanied by assurance that sufficient agreed to resources are in the FYDP and EPA or can be programmed to execute the program as recommended. DSARC review would certify the program ready to proceed to the next acquisition stage. Affordability in the aggregate would be a function of the PPBS process.

- Pro: - This would lead to DSARC endorsement of fiscally executable programs and fosters program stability through resource commitment.

- Con: - Funding constraints may be set without regard to technical issues.

Alternative Three has the DRB assume the functions of the DSARC. This also makes DepSecDef the Acquisition Executive.

- Pro: - Decisions made by single body; no need to revisit in another forum.
  - Forges a closer linkage between the acquisition process and the PPBS.

- Con: - Current DRB membership not optimal for technical program reviews.

Action Required: Alternative 2--DAE enforce current DoD Directive 5000.1 affordability policy and USDRE revise 5000.1 to strengthen policy and eliminate confusion.

Alternative 3--USDRE revise DoD Directive 5000.1/DoD Instruction 5000.2 to reflect changes in role and membership of DRB.

Decision:

Alternative 1 _____
Alternative 2 _____
Alternative 3 _____
I Need More Information _____

G. Issue: PROGRAM MANAGER CONTROL OVER LOGISTICS AND SUPPORT RESOURCES

Problem: Three programming and budgeting problems are disincentives for program managers to provide system support and readiness.

1. Support program and budget requirements are based on experience related measures (unrelated to readiness) instead of a system's support requirements and readiness factors.

2. Budget review by appropriation categories. The fielding of a weapons system involves several appropriations: RDT&E, procurement, military construction, operation and maintenance and military personnel. Normally budget decisions in these accounts occur without visibility of the impact on individual system's support or readiness.

3. Budget execution. Some weapon support funds (spares, training, depot) are controlled by Service activities not responsible to the program manager. Sometimes priorities do not match the program manager's and funds are diverted to fund other requirements.

The Program Manager may not know of or participate in PPBS decisions which impact on his system's support. Once decisions are made on his system's support, they may be altered by another activity during budget execution. This is particularly critical early in FSED as well as during the transition to production when large initial support resources are spent. At any given time, there would be an estimated 15-20 weapons total involved in transition. Procurement of spares with contracts separate from the system production contract increases spares costs.

OPTIONS: Alternatives 2 and 3 below would apply to selected weapon systems, those nearing production or in early production (15-20 systems). A two year trial is recommended for the selected alternative.

Alternative One would continue present management system (use traditional/experience related measures to review system support program and budget requirements; review budget by appropriation categories.

- Pro: - No cost of change.
- Con: - Disincentives for program manager to provide system support readiness remain. Budget review and budget execution problems are not addressed.
  - Little program manager input to support budget execution.

Alternative Two would have Services submit with the POM support resource requirements and readiness objectives, by weapon system, for systems entering/or in early production. Direct OSD to have a single review of support associated with individual systems.

Pro:

Gives more PPBS visibility of the combined effects of major support decisions on readiness objectives.

Removes PPBS disincentives by reducing independent budget/PPBS decisions without visibility of effect on program as a whole.

Would move in the direction of a more mission oriented budget decision process.

Con:

Some extra work for the reviewers.

Alternative Three is the same as two but would additionally develop procedures to give the PM more control of support resources, funding and execution. Services would develop implementing approaches to deal with the problems identified on this issue. The basic option should give the Program Manager a voice in support resource allocation and budget execution process through increased and centralized resource visibility and coordination by the PM on changes to his plans.

Pro:

Giving the Program Manager a voice (or coordination) in major support resource decisions for his program would improve responsibility.

Con:

A moderate step requires procedural changes and may or may not be effective. More direct control of many resources would unbalance the overall use of logistic resources by the Service.

Action Required: ASD(MRA&L) letter to Services stating objectives to give more incentives to PM. ASD(MRA&L) would work with the Services to define and evaluate implementing options. Initial letter can be prepared within 30 days.

Decision: Alternative 1____
Alternative 2____
Alternative 3 2
I Need More Information____

H. Issue: IMPROVING RELIABILITY AND SUPPORT FOR SHORTENED ACQUISITION CYCLE

Problem: In response to serious readiness and reliability problems in many of the systems we now operate, there have been increases in Service and OSD efforts to define reliability and support objectives and to demonstrate their accomplishment prior to major production commitment. Recent acquisition policies include this increased emphasis.

The new focus on shortening the development process is potentially in conflict with initiatives to improve reliability and support. Whereas the fastest acquisition approach involves initiating production prior to test of development models, the highest confidence of achieving reliability and other support goals in fielded hardware involves iterative design and testing before high rate production. A balance must be struck on each program. Many of the serious problems in current systems result from not striking the correct balance.

For those systems which are run on a fast track, there are requirements for additional early funding to design in reliability and support characteristics - including the need to pay this price in parallel on competing developments. Additional in-house talent must be brought to bear, and industry incentives need to be applied to avoid previously experienced support problems.

Because of the relative priority of reliability and support efforts compared to performance objectives, and the current shortage of in-house talent to address these problems, specific top management attention, priority and stress on support resources is needed.

Alternative One modifies the current acquisition procedures to require a specific early decision (circa Milestone 1 on many programs) on the approach, additional resources and incentives which will be used to balance the risks in the reliability and support area on each program. The vehicle for decision can be an acquisition strategy prepared by the Program Manager. This should include an option which goes as far as possible in extra efforts (design, parallel testing, contractual) to increase the likelihood of achievement of support objectives on concurrent programs.

- Pro:
  - Early decision on degree of concurrency sets in motion long lead steps to reduce support risks.
  - Results in conscious decision to balance all the objectives in the light of Service and DoD priorities.
  - Gets additional early resource needs considered.
  - Provides clear support objectives to PM.

- Con: - Will require more up-front funds. Will be viewed by some as addressing support too early.
  - Additional responsibility for PM (but the clear decisions may be helpful).

Alternative Two shifts more of the focus to fixing reliability and support problems experienced in fielding the system by subsequent redesign of production hardware and incorporation of fixes. Rely more on interim contractor support while problems are being fixed.

- Pro: - Easier to do.
  - Leaves program manager freer to make the trade-offs without Service involvement.

- Con: - Requires more funds to fix later. Historically difficult to get funds for major fixes. Less likelihood of avoiding support problems.
  - Congress will criticize the early fielding problems.

Action Required (If Alternative One is selected): USDRE issue guidance adding early assessment of support options to the current procedures. This could be part of a decision on overall acquisition strategy. Additionally request the Services to revise and develop support related planning guidelines.

Decision:

Alternative 1 X
Alternative 2 _____
I Need More Information _____

AN3501-#5

THE DEPUTY SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301

March 27, 1981

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARIES OF DEFENSE
ASSISTANT SECRETARIES OF DEFENSE
GENERAL COUNSEL
ASSISTANTS TO THE SECRETARY OF DEFENSE

SUBJECT: Management of the DOD Planning, Programming and Budgeting System

On 13 February 1981, I directed a 30-day assessment of the DOD PPBS. The report was delivered to me on 13 March 1981. I have discussed it with the Steering Group, the Joint Chiefs of Staff, the Service Secretaries, the Under Secretaries and selected Assistant Secretaries. Your interest, frankness and professionalism during these discussions have convinced me that we have a unique opportunity to improve significantly the way we do our planning and manage our resources.

Based on the report and those conversations, the Secretary and I have decided on the following approach.

DoD Management Philosophy

The Defense management system will focus on the major missions that the Department of Defense must address to satisfy national objectives:

— It will define the national military strategy necessary to support our foreign policy and provide security for our people.

— It will help us achieve the integrated and balanced military forces determined by the Secretary to be necessary to accomplish that strategy.

— It will help assure that we are significantly ready in all aspects to deter aggression and to succeed where armed intervention is necessary.

— It will provide the framework necessary to manage the Defense resources effectively and to insure successful mission accomplishment consistent with national resource limitations.

-- It will provide information to the Secretary to help him insure that the role of military power is properly considered in the formulation of national objectives.

Decentralization and Accountability

We will achieve better Defense management by working toward a system of centralized control of executive policy direction and more decentralized policy execution. Working with the Service Secretaries, the Chairman of the Joint Chiefs of Staff, and OSD staff, the Secretary and I will concentrate on major policy decisions, definition of planning goals and the allocation of resources necessary to strengthen the horizontal integration of our four Services into a balanced Armed Forces Team to meet our national military strategy. To support these policies and plans, we will hold each of the Service Secretaries responsible for the development and execution of the necessary programs and the day-to-day management of the resources under their control. Through this controlled decentralization, subordinate line executives will be held accountable for the execution of our approved programs and policy decisions. This will focus Service management efforts on improving the operational efficiency of each department.

This general principle, however, has two major corollaries. First, we must assure that accountability is specifically fixed, and that an improved process is available for DOD-wide performance evaluation and monitoring. Those who have the responsibility will be held fully accountable for results. I expect strong leadership and initiative by the civilian and military executives at all levels of the Department of Defense. They must manage well and assure that both the Secretary and I are kept informed on a continuous basis of major problems and issues before they surface in forums outside DOD.

Secondly, this concept must contain appropriate procedures and levers to assure that Department-wide, cross-Service and cross-command programs are planned, managed and evaluated. There must be sufficient flexibility to assure that Presidential and Secretary of Defense goals and priorities are recognized, met and maintained by the Services and line organizations. Examples include our nuclear forces, C³I, DOD-wide manpower policies, mobility forces and others that cut across individual Service lines.

My staff managers in the Office of the Secretary of Defense will be responsible for providing the technical cross-Service mission analysis and evaluations necessary to insure that our actions effectively integrate the capabilities of the Services. In addition, through their review of program execution within the departments, OSD staff will provide to the Secretary and me independent assessments of the success of our overall Defense efforts.

Participative Management

A second major management principle that both the Secretary and I espouse and expect to utilize fully is that all those that have a legitimate interest in the outcome of a management decision should participate in the decision. There are many different internal points of view on major issues and legitimately so. We want to assure that these positions are fully articulated at the appropriate level. We also encourage dissent. We must all have the courage of our convictions and express them prior to the time of decision. Once the Secretary and I have made the policy decisions, however, we insist on full support in the implementation of those decisions.

This participative principle pertains not only to the OSD-Service relationship and internally within both OSD and the Services, but cross-Service as well. On the latter point, I would like more cross-Service dialogue to take place on major program development and implementation issues regardless of whether OSD staff initiates the process. The Joint Chiefs of Staff, as well as the CINCs, could initiate such dialogue. Alternatively, the Services, with their enhanced authority and responsibility, could acknowledge and move forward on DoD-wide opportunities that cut across Service lines.

Economies and Efficiencies

We all, as part of our management responsibility, have to assure that the large amount of funds being proposed for Defense are used wisely, effectively and efficiently. We must be more aggressive and imaginative in saving money by eliminating major overlaps or duplications and assigning priorities to all programs. I look to each of you to use your enhanced authority to bring about major savings and improved methods of operation. During the programming and budgeting process, we must be straightforward with each other in looking for economies and efficiencies if our new management system is to work. I expect to enforce the necessary discipline during the entire process. Game playing will not be tolerated. We should all remember that if we do not produce some real savings and lower costs in many programs, others will do it for us.

Specific Decisions

In order to assure we follow the management principles and meet the policy objectives I have stated above, I am directing that the following actions take place, effective today.

Improved Planning

I agree with the consensus that we must both improve strategic planning in the early planning phase of the PPBS cycle and strengthen long-range planning throughout the other phases of

the PPBS. This calls for a more disciplined planning process that will provide the framework, the goals and objectives, the appropriate military strategies, and the risks associated with the optimum allocation of available resources. They, in turn, should be based on military requirements that flow from a realistic assessment of near-term and long-term threats. The major issues that will arise in the programming phase and the major budgetary decisions that follow will be measured against these planning goals and threats, not only against available budgetary resources as in the past.

This improved planning process should address the larger strategic issues and problems facing the country. Resource constraints are an important part of this strategic planning activity. But we should not allow the strategic planning process to be too narrowly constrained by fiscal and program guidance. We need the correct balance to assure realistic, serious, and pragmatic strategic planning.

Therefore, to achieve this new planning policy, I direct that USD(Policy), with strong input from JCS and R&E Resource Planning, take the lead in designing this new and improved planning approach with inputs as necessary from other OSD staffs, the Services and the CINCs. I would like a detailed plan of action on how we should proceed within 30 days.

Improved Programming

In accordance with this controlled decentralization principle, the Services will have enhanced responsibility for developing, defending, and carrying out their programs. OSD staffs, as I have discussed above, will concentrate more on major DoD policy, planning and program issues, primarily those that cut across Service lines and programs and those that are of priority Presidential and Secretary of Defense interest. OSD will, with help from the Services, design and plan for additional standardization, joint programs and joint systems, to improve efficiency and reduce costs. I hope and expect the Services to join in this effort.

The OSD function becomes at the same time more difficult and more critical. OSD must help the Secretary and me manage the organization as a whole and help us identify major problems and issues in the total system in time to act.

During this immediate FY 83-87 programming phase and thereafter, all participants should be guided by the management principles enunciated above and be responsible for the following assignments:

	Lead Offices	In Coordination With
1. Overall Policy, Strategy, Force Planning, and Planning Guidance	USD/P	JCS, Services, CINCs, OSD (NSC)

	Lead Offices	In Coordination With
2. Resource Objectives, Planning and Guidance	R&E, MRA&L	OSD and Services, as appropriate; Comptroller
3. Fiscal Guidance	COMP, PA&E	OMB, White House, USD/P
4. Program Development	Services	
5. Program Unification and Standardization	R&E	OSD
6. Program Review and Evaluation		
Consistency with policy	Nuclear: ISP Conv: ISA	PA&E, R&E, COMP PA&E, R&E, COMP
- Cost-effective force trade-offs, cross-Service balance and mutual support	PA&E	USD/P, MRA&L, R&E, COMP
- Cross-program, modernization, R&D	R&E	C3I, Policy Review, COMP, other OSD as appropriate
- Readiness, sustainability, other logistics	MRA&L	USD/P, PA&E, R&E, COMP
- Manpower program feasibility and efficiency	MRA&L	USD/P, PA&E, COMP
7. Budget Review; Cost Savings and Added Efficiencies	COMP	All of OSD, Services

As a first task, I would like each OSD lead office to provide to me a very brief paper, in 10 days, on how it would carry out its responsibilities for these assignments. Include your suggestions on how you plan to reduce substantially the information requirement of the POM preparation instruction and the budget estimate submission. Our objective will be to develop a POM that focuses primarily on major planning and policy issues.

I am setting the goal of cutting by at least 50 percent the POM documentation requirements associated with the current cycle (POM 83). It is my understanding that the response to the FY 82 POM requirements and instructions produced in one case, 2,691 pages of text and tables. Surely we can get by with half that, particularly if we begin to follow our new management principles. ASD(PA&E) should review the FY 83-87 POM preparation instructions and provide me a recommendation in 10 days on modifications that can be made to achieve the 50 percent reduction goal.

The Services also should be streamlining their internal programming and budgeting procedures. They should focus specifically on how they will provide the OSD staff and me the essential information we need to carry out our responsibilities. At a future date, I will ask the Services for a briefing and a progress report on how well they are doing.

Change of Role and Membership of the DRB

The DRB was established in April 1979 to help improve the efficiency of the PPBS, primarily by supervising the OSD review of Service POMs and the Budget Submission. I am now directing that the DRB role and membership be changed as follows:

DRB Membership

Chairman:	DepSecDef	
Executive Secretary:	The Executive Assistant to DepSecDef	
Permanent Members:	ASD(R&E)	
Chairman, JCS	ASD(HA)	Associate Director/OMB
SecArmy	ASD(MRA&L)	
SecNavy	ASD(PA&E)	
SecAir Force	ASD(C)	
USD(P)	ASD(ISA)	
USD(R&E)	ASD(ISP)	

Role of DRB

The primary role of DRB is to help the Secretary of Defense manage the entire revised planning, programming and budgeting process. I plan to hold regular monthly DRB meetings and more often if necessary, to review proposed planning guidance; to manage the program and budget review process; to advise the Secretary of Defense on policy, planning, program and budget issues and proposed decisions; to perform program evaluations and reviews of high priority programs on a regular basis; and to assure that major acquisition systems are more closely aligned to PPBS.

I expect a limited number of major issues to be raised before the DRB. Lesser issues should be decided outside the DRB forum by consensus between the Services and appropriate OSD staff and recorded by appropriate decision documents. In all cases, the consensus must reflect Departmental and Administration policy. Where consensus cannot be reached, the issue will be referred to the DRB. I also expect full coordination of DRB decision papers well before DRB meetings.

DRB members must be more than advocates of their particular areas of responsibility; they must take a broader and deeper DoD view and help the Secretary and me manage far better, this complex organization.

ZBB

The PPBS report on this subject concluded that the costs of implementing ZBB far outweighed the beneficial results. Examples were given of the tremendous amount of staff time and paper used with little effective value. I agree with these findings.

Therefore, I direct the Comptroller to begin the process of reducing the negative effects of the ZBB process on our PPBS beginning now with the FY 83-87 cycle. I would like a detailed plan on how we can do this effectively and with minimum dislocations for my approval within 10 days. Please coordinate the detailed proposal with OMB. The idea of reexamining the necessity and desirability of continuing each program is a good one. The process by which we have done this is not.

Rationalization of Data Requirements

The move toward controlled decentralization and the assignment of more responsibility to the Services raises a number of issues on the level of detailed data formerly needed by OSD for centralized analysis and control. In keeping with this management philosophy, we will have to look to the Services to maintain an adequate data bank not only to manage and execute their programs but also to keep the Secretary and OSD informed. I expect that access by OSD will be as required to resolve issues and will be freely provided by the Services. OSD will continue to maintain those centralized data banks that are mandated by statute or necessary to support the Secretary in cross-Service analysis.

The use of that data by OSD must change. OSD should exercise its access not to provide an alternative detailed analysis of Service programs but to provide the necessary joint program, cross-Service, and Secretarial priority program analysis, review and evaluation. This of course does not preclude suggesting alternatives should this be desirable; but the development and presentation of alternatives is the responsibility of line management in the first instance.

I want to assure we have a better definition of this complex issue on level of detail, data banks and categorical formats. In addition, I want to reduce further the paperwork in the PPBS and to begin to rationalize the usage of the many varieties of categories and data bases required internally and externally.

To do this, I direct that a study be mounted to develop a more consistent framework of data bases and to reduce the level of data required among OSD and the Services. An inter-OSD-Service team led by the Comptroller as chairman should do an in-depth problem analysis and array options for cutting down the massive data requirements. Please include the OMB and legislative requirements. I expect this report in 30 days.

Transition FY 83-87

We should begin to move toward the improved PPBS immediately. I direct USD(Policy) to prepare draft FY 1983-87 policy guidance, PA&E and Comptroller to prepare draft fiscal guidance and USD(R&E) and MRA&L to prepare draft resource objectives and planning guidance within 10 days. USD(Policy) should take the overall lead to pull the entire draft policy guidance package together and distribute it for review to all appropriate OSD and Service staffs. I then expect to hold the first meeting of the newly reconstituted DRB to review and approve the draft policy and fiscal guidance.

I expect a significantly reduced POM to be prepared by the Services by 15 June 1981.

The Secretary and I, in consultation with the Director of OMB, have decided that the joint OMB/OSD budget review will be continued. The precise form and nature of this review will be developed with OMB in the next several weeks.

I will regularly review progress toward achieving this new revised PPBS. As we go through the FY 83 process and begin the FY 84 planning, I will keep open the options of a biennial POM and combined program-budget review in the next cycle. Much will depend on our progress this year.

DoD Performance Review Process

The Secretary and I will soon be instituting a strong management review process through which goals, objectives, and milestones will be established and regularly reviewed by the Secretary and me for each major program.

I appreciate the time and interest you have provided during this review. Achieving the goals the Secretary and I have set will not be easy and will take time. The Secretary and I expect and know we will receive your full cooperation and your personal leadership over time to achieve our joint overall objective of revitalizing American military strength.

Frank C. Carlucci

APPENDIX C

EVOLUTION OF OSD INFLATION ESTIMATES

Tables 1, 2, and 3 respectively reflect the historical evolution of the Office of the Secretary of Defense estimates for inflation used in the computation of the current, then year, estimates of development, procurement, and military construction cost. The historical estimates of inflation are not corrected for actual inflationary experience during past years. The estimate for inflation, for each past year, used in the computation of the current estimate is the last estimate that Office of the Secretary of Defense issued for that year.[1]

Since the fiscal year 1982 budget was being prepared for submission in December of 1980, the estimate of inflation used for the budget year and all future program years was that Office of the Secretary of Defense estimate issued in December, 1980, (i.e. the current estimate of future inflation.) The source for these data was the F/A-18 Selected Acquisition Reports.

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[1]For example, note that the Office of the Secretary of Defense estimate of the inflation of F/A-18 development cost (Table 3) for 1979 was initially 4.0 percent, but was last estimated to be 7.0 percent. The 7.0 percent estimate for 1979 was used in the computation of the current estimate of total development cost.

TABLE 1

OFFICE OF THE SECRETARY OF DEFENSE

ESCALATION ESTIMATES - DEVELOPMENT

ESCALATION ESTIMATE FOR FISCAL YEAR:

Source F/A-18 SAR Dated As of	76	TT	77	78	79	80	81	82	83	84	85	86	87	88	89
Mar 76 (DE)	9.0	2.3	7.0	7.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dec 76				7.0	7.0	4.4	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dec 77					7.0	6.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dec 78						6.3	5.8	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Dec 79							8.8	8.2	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Dec 80								9.0	7.9	7.1	6.2	6.2	6.2	6.2	6.2
Inflation Rates used in Computation of Current Estimate of Development Cost	9.0	2.3	7.0	7.0	7.0	6.3	8.8	9.0	7.9	7.1	6.2	6.2	6.2	6.2	6.2
	Historical Estimates (Not Corrected for Actual Inflationary Experience)						Current Estimate of Future Inflation								

TABLE 2

OFFICE OF THE SECRETARY OF DEFENSE

ESCALATION ESTIMATES - PROCUREMENT

ESCALATION ESTIMATE FOR FISCAL YEAR:

Source F/A-18 SAR Dated As of	76	TT	77	78	79	80	81	82	83	84	85	86	87	88	89
Mar 76	9.0	2.3	9.0	7.0	7.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dec 76				7.0	4.0	4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dec 77					6.0	5.8	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Dec 78						6.2	5.6	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Dec 79							9.0	8.5	7.8	7.0	6.1	6.1	6.1	6.1	6.1
Dec 80								9.3	8.2	7.3	6.2	6.2	6.2	6.2	6.2
Inflation Rates used in Computation of Current Estimate of Procurement Cost	9.0	2.3	9.0	7.0	6.0	6.3	9.0	9.3	8.2	7.3	6.2	6.2	6.2	6.2	6.2
	Historical Estimates (Not Corrected for Actual Inflationary Experience)						Current Estimate of Future Inflation								

TABLE 3

OFFICE OF THE SECRETARY OF DEFENSE

ESCALATION ESTIMATES - MILITARY CONSTRUCTION

ESCALATION ESTIMATE FOR FISCAL YEAR:

Source F/A-18 SAR Dated As of	76	TT	77	78	79	80	81	82	83	84	85	86	87	88	89
Mar 76 (DE)	9.0	2.3	7.0	7.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dec 76				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Dec 77					7.0	6.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Dec 78						7.0	6.5	6.3	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Dec 79							8.9	8.1	7.5	6.9	6.6	6.6	6.6	6.6	6.6
Dec 80								8.9	7.9	7.2	6.7	6.7	6.7	6.7	6.7
Inflation Rates used in Computation of Current Estimate of Military Construction cost	9.0	2.3	7.0	5.0	7.0	7.0	8.9	8.9	7.9	7.2	6.7	6.7	6.7	6.7	6.7
	Historical Estimates (Not Corrected for Actual Inflationary Experience)						Current Estimate of Future Inflation								

APPENDIX D

METHODOLOGY FOR CALCULATION OF F/A-18
COST GROWTH DUE TO UNRECOGNIZED INFLATION
WITH WORKSHEETS ATTACHED

1. Program Funding (Escalated $)

a. Current & Prior Years - Enter the program funding amounts in escalated or "actual" dollars for each fiscal year (FY) prior to the Budget Year. Their sum should equal the amount shown under column 4 on Format E of the SAR. (The SAR's are not included in this appendix because of security classification; however, they are available from the Naval Air Systems Command and from Congressional sources.)

b. Budget Year & FYDP through to Complete - Enter the program funding amounts in escalated dollars for each fiscal year shown under the "Current Estimate" column on Format H of the SAR.

c. Total - Enter the total program funding (this appropriation) in escalated dollars. This amount is the sum of all entries in the "Program Funding (Escalated $)" row. It should equal the amount shown under column 8 on the Format E of the SAR.

2. Program Funding (Base Year $)

a. Current & Prior Years

(1) Base Year to Budget Year - Enter the base year dollars for each FY from the Base Year to the Budget Year.

b. Budget Year & FYDP through to Complete - Enter the base year dollars for each fiscal year from the Budget Year

to program completion. Each FY dollar amount should equal the Current Estimate FYxx minus Escalation Amount FYxx shown on Format H of the SAR.

c. Total - Enter the total program funding (this appropriation) in base year dollars. This amount is the sum of all entries in the "Program Funding (Base Year $)" row. It should equal the amount shown under column 3 on Format E of the SAR plus pre-base year escalation shown in the "Footnote" of the SAR, where applicable.

3. Program Escalation

a. Current & Prior Years - Enter the amount of escalation "Program Funding (Escalated $)" minus "Program Funding (Base Year $)" for each fiscal year (FY). Do not make any adjustments for pre-base year dollars in this row.

b. Budget Year & FYDP through to Complete - Enter the amount of escalation "Program Funding (Escalated R)" minus "Program Funding (Base Year $)" for each FY. The values in each FY should equal those shown under "Escalation Amount" on Format H of the SAR.

c. Total - Enter the total program escalation amount (this appropriation). This amount is the sum of all entries in the "Program Escalation" row. It should equal the total appropriation escalation entry shown under the Escalation or Remarks columns on Format G.1 (Cost Variance Analysis chart) of the SAR plus the pre-base year escalation shown in the

"Footnote" of the SAR, where applicable. As a double check, it should also equal the total (this appropriation) from column 8, Format E, minus the base year $ total (this appropriation) from column 3, Format E, minus the pre-base year escalation shown in the "Footnote" of the SAR, where applicable.

4. Annual Escalation Rate - These rates should be the annual rates used to develop the "Composite Escalation Index" that lets you change between program "Escalated" dollars and "Base Year" dollars. EXCEPTION: FY7T is a "periodic" rate (e.g., quarterly). If necessary, adapt format to reflect Service peculiar instructions for handling the "transition" year.

a. Current & Prior years - Enter the program's annual escalation rate for each fiscal year (FY). These should be the annual rates used to develop the "Composite Escalation Index" for the Budget Year.

b. Budget Year & FYDP through to Complete - Enter the program's annual escalation rate for each FYDP fiscal year. These rates should equal the rates shown under "Escalation Rate" on Format II of the SAR.

5. Compound Escalation Index - Develop a compound escalation index using the program's "Annual Escalation Rated." Assign the program base year a value of 1.000. Enter the index for each fiscal year (FY) as a decimal.

Generic example (not F/A-18 Data)

Fiscal Year	Annual Rate	Compound Index
FY7T	2.30	0.885 = .947 ÷ 1.07
FY77	7.00	0.947 = 1.000 ÷ 1.056
FY78 (Base Year)	5.60	1.000
FY79	6.00	1.060 = 1.000 x 1.060
FY80	6.20	1.126 = 1.060 x 1.062

6. Outlay Rates - Enter the program's outlay rate (sometimes called expenditure rate) as a percent for each fiscal year (FY). These rates should be the outlay rates used to develop the "Composite Escalation Index:" this permits a change between program "Escalated" dollars and "Base Year" dollars.

Outlay Percentage

Outlay Year	FY 197T	FY 1978	FY 1979
APPN FY	2	19	10
FY+1	27	36	36
FY+2	56	29	39
FY+3	11	8	8
FY+4	3	6	6
FY+5	1	2	1
TOTAL	100%	100%	100%

7. Composite Escalation Index - Enter the program's Composite Escalation Index (sometimes called outlay-weighted index) for each fiscal year (FY). The Composite Escalation Index results from the mathematical combination of the program's "Compound Escalation Index" and "Outlay Rates." Example: Composite Escalation Index (FY 1977).

	FY78		FY79		FY80		FY81		FY82		FY83		TOTAL
Compound Escalation Rate	1.000		1.060		1.126		1.227		1.334		1.414		-
x	x		x		x		x		x		x		
Outlay Rate	0.190		0.360		0.290		0.180		0.060		0.020		1.000
Composite Escalation	0.190	+	0.382	+	0.327	+	0.098	+	0.080	+	0.028	=	1.105

A complete explanation of how to prepare the Composite Escalation index is found in the SAR "Preparation and Review" Guide, DoD 7000.3-G, page 4-1 to 4-14.

8. Calculated Program Funding (Base Year $)

a. Current & Prior Years through to Complete - Enter the base year dollar amount obtained by dividing "Program Funding (Escalated $)" in each fiscal year by the corresponding "Composite Escalation Index."

b. Total - Enter the calculated total program funding (this appropriation) in base year dollars. This amount is the sum of all entries in the "Calculated Program Funding (Base Year $)" row.

The "Calculated Program Funding (Base Year $)" row may not be the same as the "Program Funding (Base Year $)" row. The reasons for differences between the two base year programs include:

(1) improper escalation calculation; and

(2) not adjusting the program base year estimate in years where "actual" escalation rates differ from those projected in the budget.

9. On the attached worksheets the cost growth due to Unrecognized Inflation equals the Program Funding (Base R) minus Calculated Program Funding (Base R).

RECOGNITION OF UNRECOGNIZED INFLATION
F/A-18
($M)

AS OF DATE 31 DEC 81
BASE YEAR 1975

APPN: DEVELOPMENT

PROGRAM FISCAL YEAR	BASE YEAR FY 75	FY 76	FY 77	FY 77	FY 78	FY 79	FY 80	BUDGET YEAR FY 81	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	TOTAL
PROGRAM FUNDING (ESC $)	20.[illegible]	109.8	22.2	340.7	625.1	494.6	313.3	129.1	151.4	32.0	8.3	4.3	2.1				2253.4
PROGRAM FUNDING (BASE $)							1474.9*	80.1	32.2	16.4	4 2	1.9	0.9				1661.6
PROGRAM ESCALATION							450.8*	49.0	68.2	15.6	4.6	2.4	1.2				591.8
ANNUAL ESCALATION RATE		8.7	2.0	8.2	8.9	21.3	11.5	11.3	9.0	7.9	7.1	6.2	6.2	6.2	6.2	6.2	(NO CHANGE)
COMPOUND ESCALATION INDEX	1.000	1.087	1.087	1.200	1.306	1.454	1.621	1.804	1.967	2.122	2.273	2.414	6.564	2.722	2.691	3.070	
OUTLAY RATES																	
1ST YEAR	58.0	58.0	10.0	58.0	63.0	59.85	59.5	55.17									
2ND YEAR	26.0	12.0	60.0	34.5	30.C	32.15	30.5	35.83	(NO CHANGES)								
3RD YEAR	12.0	28.0	28.0	5.0	5.0	6.0	6.6	7.0									
4TH YEAR	.5	.5	.5	1.5	1.0	1.0	2.1	2.0									
5TH YEAR	1.5	1.5	1.5	1.0	1.0	1.0	1.3										
6TH YEAR																	
COMPOSIT ESCALATION INDEX	1.0460	1.1278	1.2280	1.2620	1.3780	1.541	1.719	1.894	2.053	2.205	2.353	2.499	2.65[illegible]				
CALCULATED PROGRAM FUNDING (BASE $)	19.1	97.4	18.1	269.9	453.6	321.0	182.3	68.2	73.7	14.5	3.7	1.7	0.8				1524.0
UNRECOGNIZED INFLATION																	[illegible].6

*PRIOR YEARS TOTALS

RECOGNITION OF UNRECOGNIZED INFLATION
F/A-18
($M)

AS OF DATE 31 DEC 81
BASE YEAR 1975

APPN: PROCUREMENT

PROGRAM FISCAL YEAR	BASE YEAR FY 75	FY 76	FY 77	FY 78	FY 79	FY 80	BUDGET YEAR FY 81	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	TOTAL
PROGRAM FUNDING (ESC $)				34.1	540.7	1119.7	1917.3	2285.0	2589.2	2926.7	3838.3	5133.9	5240.1	5148.2	4798.9	35571.9
PROGRAM FUNDING (BASE $)						954.3*	1116.7	1090.5	1155.3	1257.3	1515.5	1914.0	1838.1	1699.6	1502.3	14065.6
PROGRAM ESCALATION						740.2*	750.6	1194.5	1432.9	1698.4	2322.6	3219.9	3402.0	3448.6	3296.6	21506.3
ANNUAL ESCALATION RATE		10.1	2.5	8.3	9.0	11.5	12.8	14.1	9.3	8.2	7.3	6.2	6.2	6.2	6.2	6.2 No Change
COMPOUND ESCALATION INDEX	1.000	1.101	1.128	1.222	1.332	1.485	1.676	1.912	2.090	2.261	2.426	2.576	2.736	2.906	3.066	3.277
OUTLAY RATES																
1ST YEAR	8.0	11.0	1.0	13.0	13.0	15.0	12.0	14.13	14.13							
2ND YEAR	9.0	9.0	19.0	37.0	37.0	42.0	43.0	41.36	40.87							
3RD YEAR	36.0	45.0	45.0	32.0	32.0	35.0	29.5	25.51	26.0	(NO CHANGES)						
4TH YEAR	30.0	16.0	16.0	11.0	11.0	5.0	9.5	14.0	14.0							
5TH YEAR	15.0	16.0	16.0	4.0	4.0	2.0	4.0	3.5	3.5							
6TH YEAR	2.0	3.0	3.0	3.0	3.0	1.0	2.0	1.5	1.5							
COMPOSIT ESCALATION INDEX	1.1816	1.2737	1.4061	1.4504	1.6207	1.7699	2.0032	2.1822	2.3501	2.5118	2	3	2.8367	3.0127	3.1993	3.3975	3.6081	
CALCULATED PROGRAM FUNDING (BASE $)					21.0	305.5	555.0	878.6	972.3	1030.8	1095 7	1353.0	1704.1	1637.9	1515.3	1330.0	12403.2	
UNRECOGNIZED INFALTION																		1662.4

*PRIOR YEARS TOTALS

RECOGNITION OF UNRECOGNIZED INFLATION
F/A-18 HORNET
($M)

AS OF DATE 31 DEC 81
BASE YEAR 1975

APPN: MILCON

PROGRAM FISCAL YEAR	BASE YEAR FY 75	FY 76	FY 77	FY 78	FY 79	FY 80	BUDGET YEAR FY 81	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	TOTAL
PROGRAM FUNDING (ESC $)			1.0			6.2	0.8	10.1	11.8	13.2	9.0	6.6	6.2			64.9
PROGRAM FUNDING (BASE $)						4.4*	0.6	3.9	7.2	6.0	3.8	2.6	2.3			30.8
PROGRAM ESCALATION						2.8*	0.2	6.2	4.6	7.7	5.2	4.0	3.9			34.1
ANNUAL ESCALATION RATE	4.0	1.6	8.6	12.4	13.6	10.7	7.93	8.9	7.9	7.2	6.7	6.7	6.7	(NO CHANGE)		
COMPOUND ESCALATION INDEX	1.040	1.057	1.148	1.290	1.465	1.622	1.751	1.906	2.057	2.205	2.353	2.510	2.679			
OUTLAY RATES																
1ST YEAR	7.0	1.0	8.0	4.0	6.0	13.0	20.0									
2ND YEAR	11.0	17.0	42.0	41.0	42.0	35.0	45.0									
3RD YEAR	39.0	39.0	30.0	30.0	32.0	32.0	20.0	(NO CHANGES)								
4TH YEAR	26.0	26.0	10.0	17.0	11.0	11.0	8.0									
5TH YEAR	7.0	7.0	5.0	3.0	5.0	5.0	3.0									
6TH YEAR	6.0	6.0	5.0	5.0	4.0	4.0	4.0									
COMPOSIT ESCALATION INDEX	1.2430	1.3860	1.418	1.597	1.730	1.864	1.967	2.119	2.270	2.424	2.586	2.760	2.945			
CALCULATED PROGRAM FUNDING (BASE $)			0.7			3.3	0.4	4.8	5.2	5.4	3.5	2.4	2.1			27.8
UNRECOGNIZED INFLATION																3.0
PRIOR YEARS TOTALS																

APPENDIX E

OSD(C) STAFF WHITE PAPER: (FALL 1981)

BUDGETING FOR INFLATION

Problem: Current budgetary procedures are not sufficient to protect planned Defense programs from erosion due to inflation. As a result, recent Defense budgets have less real growth than planned because of the subsequent effects of higher than anticipated inflation. The problem is most severe in major weapon programs that spend out slowly and necessarily are priced under the assumption of rapidly declining inflation rates in future years.

Background: OMB Circular A-11 permits inflation budgeting throughout the government, including all Defense purchases from the private sector. In the past, however, OMB directed rates for inflation have been materially below actual inflation, leading to difficulties in budget execution.

Errors in the forecast rate of inflation affect DoD significantly because defense programs are usually fully funded in the year when they are authorized, although the monies may not be spent for several years. The full funding includes an allowance for inflation, based on the OMB forecast. If the forecast proves too optimistic, the appropriated amounts will be inadequate, since there is no provision for subsequent adjustments to offset unanticipated inflation.

Moreover, in recent years this problem has been exacerbated by another development. The recently inaugurated Department of Commerce defense deflator, which is based upon a special survey of defense goods, indicates that prices for defense purchases have been rising more rapidly than those of most goods and services in the economy, as measured by the GNP deflator. Yet under current procedures DoD must use a GNP deflator for its budget planning, not a defense deflator that properly accounts for how its purchases differ from the economy-wide average.

Discussion of Alternatives: Three solutions for reducing the loss to inflation have been proposed: (1) a separate deflator and supplemental appropriations to adjust for the error in the forecast; (2) budget at OMB projected rates and seek supplemental appropriations if realized inflation exceeds those projected rates; (3) request the Congress to appropriate Defense programs without regard for any future inflation and then later add whatever amount may be needed to cover inflation.

1. A Separate Deflator: This proposal calls for use of a separate Defense deflator, based on the established differences in the Defense and the GNP "market baskets," and supplemental appropriations if inflation exceeds the forecast or rescissions if the forecast is too high.

Pro:

If a more appropriate index were accurately projected, then inflation underfunding would be less likely.

The Commerce Defense Price Series supports the conclusion that a separate index would be better than the GNP deflator.

Con:

OMB has objected strongly and publicly to a separate Defense deflator. A separate deflator may be viewed by some as backing away from the President's economic program.

It would be a signal, especially to the defense contractor, that our program could be effectively "indexed" and there would be less incentive for efficiency and cost reduction.

The low estimate of inflation probably results as much from a low forecast as from using the "wrong" index. Historically, a separate index, projected consistently with the economic assumptions, would still have resulted in the need for supplemental appropriations.

2. Budget at OMB Projected Rates and Seek Supplementals: This proposal incrementally funds the added inflation as it is measured and reported through the Commerce Defense Price Index. The OMB projected indices would be used in the initial requests.

Pro:

Does not require OMB to recede from the strong objection to a separate Defense index.

Evidences continued support of the President's economic program and is consistent with the Secretary's testimony that he will submit a supplemental if the inflation estimates are too low.

Hedges the risk of congressional disapproval by splitting the inflation funding and continuing to support the full funding concept.

Fits into the current budget procedures of both the legislative and executive branches with only slight modification.

Funds inflation at the appropriation level with the applicable Service or Agency allocating the funds by line item.

Con:

Produces the inflation funding later than a separate index would.

May not provide full recovery for inflation since OMB or Congress will probably discount the request to provide an incentive for management.

3. Constant Dollar Budget and Incremental Funding: This proposal calls for the Congress initially to appropriate amounts for Defense without regard for future inflation and then later to appropriate whatever is needed to cover inflation, thereby maintaining Defense purchasing power. The appropriations to increase Defense funding, by the amount prices had increased, would be made in increments as inflation occurred.

Pro:

Incremental funding would eliminate loss of program to inflation if it could be fully implemented and supported by the Congress. The primary objective is to get Defense out of the inflation projection business entirely. Instead, DoD would concentrate on pricing the program accurately in constant dollars, based on the premise that DoD would do better taking chances with explicit downstream cuts than risking the implicit taxation of Defense programs that has resulted from low estimates of inflation.

It would ease the turmoil that results when the economic assumptions are changed several times a year, in particular just as the budget is put to bed in December of each year.

Inflation is incrementally funded by all our NATO allies and Japan.

Con:

Unless estimates are in constant actual year dollars, agreement with OMB on estimates of current and budget year rates would still be required, even if subsequent years could be excluded.

An explicit allowance for unbudgeted Defense inflation, required to compute the Federal deficit, would reveal aggregate inflation assumptions unless the constant dollar approach were applied government wide.

Although it is possible this can be done without upsetting the present motivation to bid on defense contracts, it may well involve the assumption of larger contingent liabilities by the Government, because less of the total funds necessary to procure a given program will be in hand at the time of contract negotiation. U.S. allies have to varying degrees managed this problem, but their relationship with industry is different than ours.

Because Congress has been hesitant in the past to grant supplementals for inflation, there is substantial risk of major cuts in the increments. The FRG and other Western European countries now are discovering these risks of incremental budgeting as fiscal pressures begin to force cuts in programs already well underway.

Verifiable data on the actual cost experience of at least major procurement contractors will be required. We do not presently have a system that provides such information. Setting it up may be difficult, particularly at the subcontractor or vendor level and may be perceived as an increase in government control and regulation.

LIST OF REFERENCES

1. Department of the Navy, Department of the Navy RDT&E Management Guide, Washington, D.C., Government Printing Office, 1979.

2. U.S. Congress, House, Hearing on Department of Defense Authorization for 1981, H181-104, 96th Congress.

3. "Air Combat Fighter," Aviation Week and Space Technology, 15 November 1975.

4. Anthony, Robert N. and Herzlinger, Regina E., Management in Non-Profit Organizations, Homewood, Illinois: Richard D. Irwin, Inc., 1980.

5. Hellriegel, Don and Slocum, John W. Jr., "Organizational Design: A Contingency Approach," Business Horizons, Vol. 16, No. 2, April 1, 1973.

6. Hicks, Herbert G., The Management of Organizations, New York: McGraw-Hill Book Company, 1967.

7. Archibald, Russell D., Managing High-Technology Programs and Projects, New York: John Wiley & Sons, 1976.

8. Galbraith, John Kenneth, The New Industrial State, New York: The New American Library, 1968.

9. Dews, Edmund, et al, Acquisition Policy Effectiveness: Department of Defense Experience in the 1970's, R-2516-DR&E Report prepared for Office of the Under Secretary of Defense for Research and Engineering, Santa Monica, California: The Rand Corporation, Oct. 1979.

10. Department of Defense Instruction 5000.2, "Major System Acquisition Procedures," March, 1980.

11. Handler, G. S., Navy Program Manager's Guide, Naval Weapons Center, China Lake, California, December 1980.

12. Department of Defense Instruction 5000.1, "Major System Acquisition," March 1980.

13. Naval Postgraduate School, Practical Comptrollership Course Student Text, Monterey, California, 1979.

14. McKinney, Jerome B., and Howard, Lawrence C., Public Administration: Balancing Power and Accountability, Oak Park, Illinois: Moore Publishing Company, Inc., 1979.

15. Department of the Army, Office of the Chief of Staff, Program Analysis and Evaluation Directorate, "PPBS Handbook," 1979.

16. Anthony, Robert H., and Herzlinger, Regina E., Management Control in Non-Profit Organizations, Homewood, Illinois: Richard D. Irwin, Inc., 1980.

17. Sniegon, Virginia A., An Evaluation of the Navy's Selected Acquisition Reports, Fort Belvoir, Virginia: Defense Systems Management College, 1976.

18. Department of Defense, Office of the Assistant Secretary of Defense (Comptroller). Preparation and Review of Selected Acquisition Reports, May 1980.

19. Davis, Guy W., "Dilemma of Uncertainties in Program Management Offices," unpublished study project report, Defense Systems Management School, 1976.

20. Drake, Hudson B., "Major DoD Procurements at War with Reality," Harvard Business Review, January-February, 1970.

21. Corley, Parris L., and Roscoe, Arthur J., Jr., "Cost Control in Air Force System Acquisition," unpublished research report, Air War College, Air University, 1975.

22. Wonnacott, Thomas H., and Wonnacott, Ronald J., Introductory Statistics, New York: John Wiley & Sons, 1977.

23. Armed Services Procurement Regulation Manual for Contract Pricing, ASPM No. 1, Chicago: Commerce Clearing House, Inc., September 1975.

24. McDonald, Paul R., Improvement Curves, Covina, California: Procurement Associates, Inc., 1973.

25. Quade, E. S., Analysis for Public Decisions, New York, Elsevier North Holland, Inc., 1975.

26. Hitch, Charles J., "Decision-making in the Department of Defense," lecture in H. Rowan Gaither Series in Systems Sciences, 1965, University of California, Berkeley. Reproduced (Hand out V-11) by DRMEC, Naval Postgraduate School, Monterey, California.

27. Sapolsky, Harvey M., The Polaris System Development, Cambridge, Massachusetts: Harvard University Press, 1972.

28. General Accounting Office, "F/A-18 Naval Strike Fighter: Its Effectiveness is Uncertain," PSAD-80-24, February, 1980.

29. Packard, David, "Improving R&D Through Prototyping," published in NASA Seminar on Prototyping, 23-24 February, 1972.

30. Logistics Management Institute, Introduction to Military Program Management, LIM TASK 69-28, March, 1971.

31. Padgett, Thomas C., "An Examination of the Relationship Between Inflation and Cost Overruns in Defense Contracts and the Adequacy of Various Types of Price Indexes in Explaining these Relationships," unpublished D.B.M. dissertation, Florida State University, 1975.

32. General Accounting Office, "Application of Design-to-Cost Concept to Major Weapon System Acquisitions," PSAD-75-91, June 1975.

33. Lee, Lamr, Jr., and Dobler, Donald W., Purchasing and Materials Management: Text and Cases, New York: McGraw-Hill Book Co., 1977.

34. Samuelson, Paul A., Economics, an Introductory Analysis, New York: McGraw-Hill Book Co., 1970.

35. McConnell, Campbell R., Economics, New York: McGraw-Hill Book Co., 1966.

36. Meiselman, David I., "Deficits, Money and the Causes of Inflation," The Wall Street Journal, July 21, 1981, Editorial Page.

37. Carson, Clarence B., The Rebirth of Liberty, New Rochelle, New York: Arlington House, 1974.

38. Walsh, C.M., "History and Theory of Price Index Numbers," Encyclopedia of Social Sciences, VII, pp. 652-655.

39. Campbell, H. G., Aerospace Price Indexes, 5-568-PR Report to the United States Air Force Project RAND, Santa Monica, California, December 1970. Santa Monica, California: The Rand Corporation, 1970.

40. Department of Defense Instruction 5000.33, "Uniform Budget/Cost Terms and Definitions," August 15, 1977.

41. Naval Audit Service, Audit Report K30018 F/A-18 Aircraft Acquisition Project of the Naval Air Systems Command, Falls Church, Virginia, 15 September 1978.

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